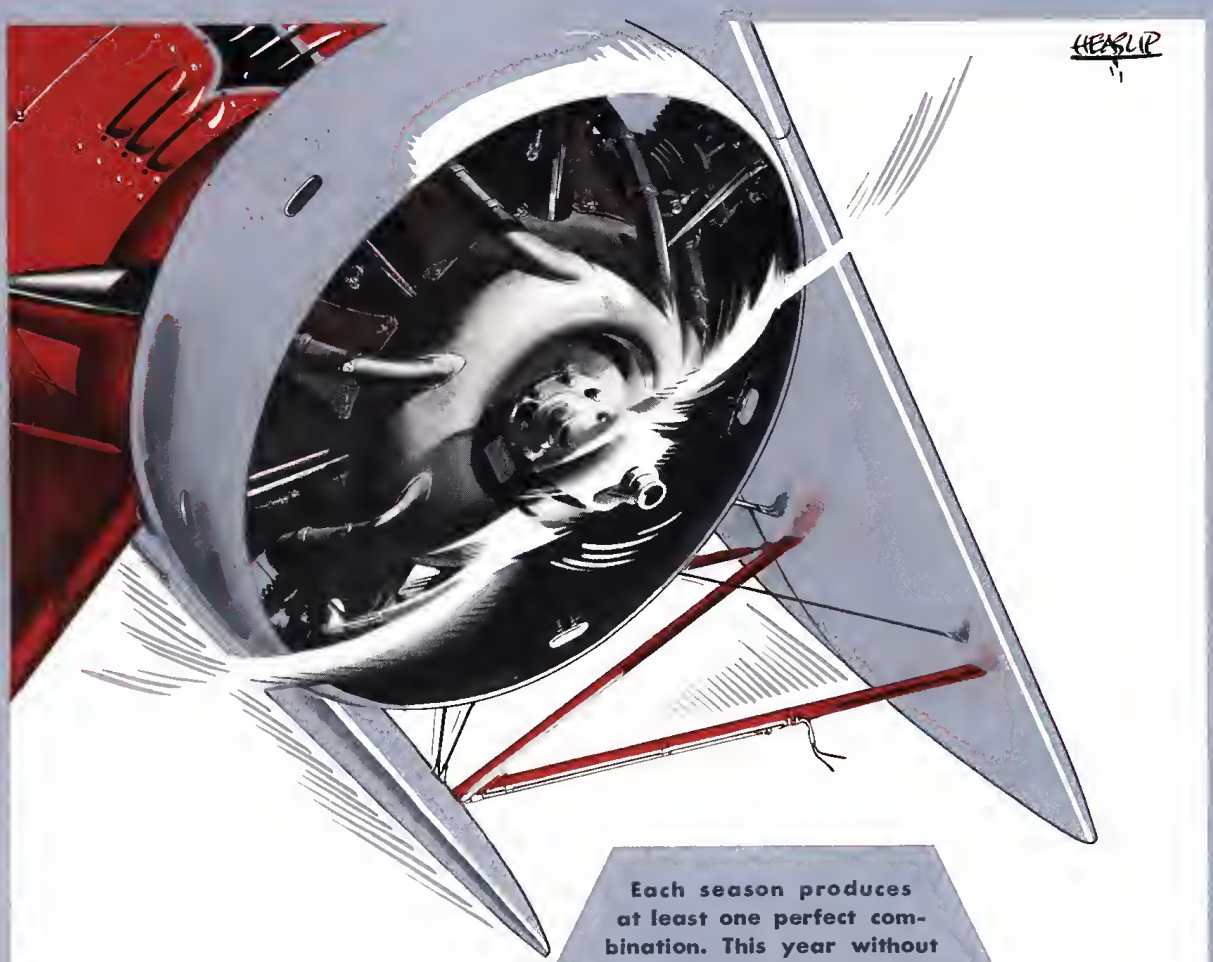
McGraw-Hill Publishing Company, Inc. JUNE, 1932 Price 35c. per copy

AVIATION

The Oldest American Aeronautical Magazine



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AVIATION

Est. 1916 — McGraw-Hill Publishing Company Inc

The Oldest American Aeronautical Magazine

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Contents for June, 1932

Volume 31, Number 6

Published monthly. United States and Mexico $4.00. Canada (including Canadian duty), $5.00. Central and South America, $6.00 a year. All other countries, $8.00 a year. U. S. currency or 40 shillings. 50 cents a copy. Entered as second-class matter July 07, 1928, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

McGraw-Hill Publishing Company, Inc., 330 West 42d St., New York, N. Y.

Cable Address: MCGRAWHILL, N. Y.

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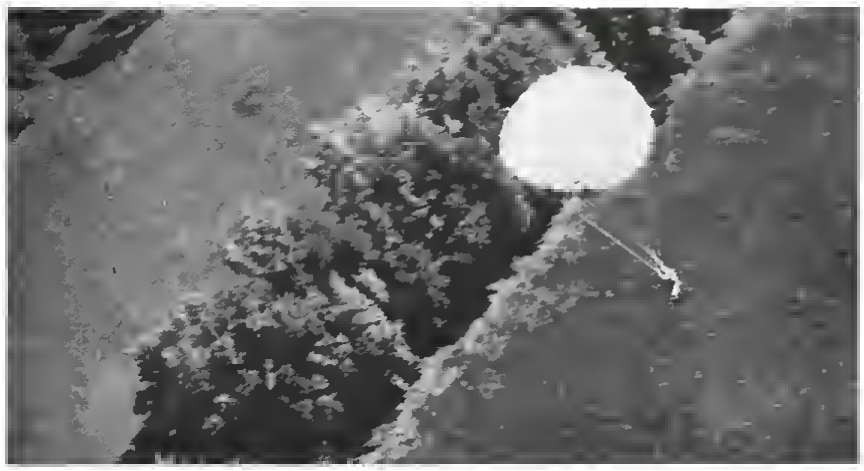

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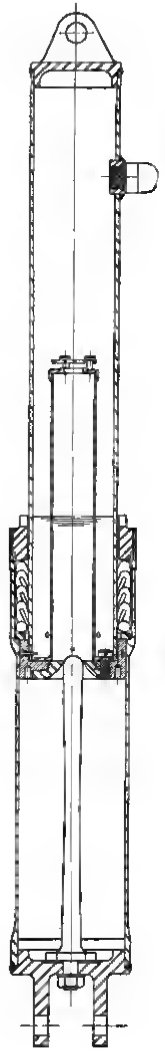


AVIATION
FOR JUNE, 1932

The equipment of air forces

I. THE UNITED STATES OF AMERICA

By Edward P. Warner

¶ In the development of airplane manufacture the demands of military and naval air forces have played, and still play, a predominant part. In spite of the steadily growing importance of air transport and other commercial operations, and of the increasing use of private aircraft, the aggregate value of military production has been in excess of the production for non-military purposes in thirteen out of the last fifteen years. In 1932, the military markets promise to be fully two-thirds of the total. ¶ There are a favored few among the members of the staffs of the companies building equipment for the Army and Navy who find it a comparatively easy matter to keep abreast of military progress. Their duties take them constantly to Wright Field or Anacostia or to sea with the fleet. For most of us in the industry, however, the problem of keeping informed on what is going on is a difficult one. Spectacular items are revealed from time to time, or the performance of some new machine is released to the press. It remains a very troublesome matter to see the field as a whole even for one's own country, to say nothing of properly appraising the relative state of development and the design trends in foreign lands. Even for the personnel of the services, unless they have been in aviation for a long time and acquired perspective on development by watching it take place, and unless they have been stationed at one of the fields to which new planes are sent for trial, it is hard to size up the subject of service equipment. In a series of articles, of which this is the first, we are trying to overcome some of these difficulties and to show the present state of technical development in military aviation throughout the world, how it got to where it is now, and where it appears to be going next.

THE whole development of the equipment of military aviation is comprehended in the active flying life of one man. As a lieutenant, in 1909, Benjamin D. Foulois rode as a passenger in the flight which determined that the United States Army would buy the world's first military airplane. It further determined that the price to be paid would include a bonus for having made a speed of 42 m.p.h., exceeding the prescribed maximum by four miles. Today, become Major General and Chief of Air Corps, Benjamin D. Foulois issues "directives" for the design of heavy bombing planes required to make at least three miles a minute, or four and a half times the speed that was record-breaking 23 years ago.

In the Navy, too, an individual can write the whole history of service aviation material from personal experience. Among the first orders to assign naval officers for aeronautical duty were a set that sent John H. Towers to learn to fly at the Curtiss school in San Diego. The same John H. Towers, risen from lieutenant to captain in the Navy, has lately commanded the Navy's first aircraft carrier and been assistant chief of the Bureau of Aeronautics and is now Chief of Staff, Aircraft Squadrons, Battle Fleet. When Lieutenant Towers went to San Diego in 1911 there was no such thing as a seaplane, and airplane-carrying ships and airplane catapults had hardly been dreamed of. If carriers, catapults, and the seaplanes were all suddenly to be wiped out now we should have almost as little naval aviation as we did in 1911.

The general tendency of materiel development of the last few years has been for the demands from the two services to converge in general characteristics, and to diverge in detail. Superficially, for example, Army and Navy fighting planes look much more nearly alike now than they did ten years ago. Closer investigation shows an immense number of differences in detail. Each service has demanded equipment to meet its special problems as they arose and to fit its particular doctrine. A fighter that bases on an airplane carrier, reaching its flying field on an elevator, constantly subject to the corrosive effects of salt air, and having to be landed on a flying field 400 ft. long, one end of which may be rising and falling some 20 ft. as the approach for landing is made, is one thing; a fighter, or pursuit plane, that must be

Army Air Corps photos

A group of old timers. The original DH-4 (top, left), of which American factories built 9,000; (top right) the Lepere, designed in 1918 and built by the Packard Company; the CO-4 of 1921 (above) Anthony Fokker's introduction to American aviation

flown across areas protected by intensive anti-aircraft fire and that must do long patrols up near the edge of the stratosphere, that must be able to use fields 10,000 ft above sea-level, and that faces the possibility of having to base on hastily-prepared grounds with no hangars at all, is quite another

Years ago, before the dominance of the aircraft carrier, Army and Navy fighting planes did not even resemble each other in general appearance, but in one type of aircraft there has always been a considerable measure of similarity except in size. The Navy's observation planes have had to be kept down to a gross weight within the capacity of the standard battleship catapult. The Army has had no such limitations, but except for weight and power the differences in specifications have been of secondary significance, and the present standard Navy observation plane originally sprang, fourteen years ago, from a root planted in Army soil.

Observation planes

The end of the war found American military observation aviation cursed with a surfeit of riches, if that term can be applied to the Liberty-engined DH-4. Some 5,000 of them had been built in the fevered mass production of the last year of the war, and in 1920 they stood in serried ranks at the Middletown depot while Liberty engines never moved from the original boxes were stacked to the ceiling at Little Rock and elsewhere. At the end of 1925, something over 1,000 DH-4's still stood upon the Army roster. They remained an important factor until 1928, and the very last of them disappeared only in 1932.

The DH-4 had been taken over from England, and adapted to carry a Liberty engine in place of the 275-hp Rolls Royce that was its regular power plant in England. Construction of American DH's had hardly started when there began to be manifested that interest in "official design" which played a large part over the next five years in the Army, and up to about 1928 in the Navy. The first move at the Air Corps Engineering Division headquarters was to revamp the DH-4 into a "general purpose" airplane, equally equipped for observation, direct or photographic, fighting, and day bombing. The war ended, and practically none were built.

The ideal of an all-purpose airplane soon lost its charms and gave way to an extreme diversification of types. In 1920 the Army was listing requirements for sixteen distinct types of planes, including three classes of observation machines. With occasional variations the tendency since that time has been back toward simplification and concentration into a few general categories. In 1932 only one observation type is recognized for purchase in very large quantities. Experiments continue also, with long-distance observation planes, or Army observation as opposed to the corps observation type, as a special group demanding distinctive elements in their design. The infantry liaison plane, a machine with its vital parts armored, and intended to operate along trench lines at low altitudes or to keep in touch with beleaguered bodies of troops, has disappeared from the Air Corps' philosophy. A war like that of 1914-18 would again create, in due course, specialized airplanes like those of 1914-18, but it is impossible to develop in time of peace, still less to procure in quantity, specialized aircraft to meet every imaginable contingency that might arise in any imaginable campaign.

For several years after the war attempts were made to develop radically new designs. The industry was invited to try its hand, and a member of design competitions were held, open not only to established manufacturers and inventors, but also to individual engineers. They resulted in the Army's acquiring a large number of pretty pictures of airplanes, and a much smaller number of actual flying machines. At the same time, three distinct design units were organized at McCook Field and developed a number of planes which were built in the Army shops. The monoplane had its first trial for observation use in the United States in the CO-1, designed by I. M. Laddon at McCook Field, and the same airplane represented the first American venture in all-metal construction with corrugated wing covering. Another of the corps observation series of 1921-23, the CO-4, was notable as the first introduction of Anthony H. G. Fokker to the American market. But none of the numerous CO's provided exactly what was wanted, and none were put into production.

The evolution of a type. The Liberty-engined Douglas O-2 of 1924 (below), the Douglas O-38 of 1931 (bottom left), and (bottom right) an all-metal product on similar lines with metal structure and metal-covered fuselage, the Thomas Morse O-19C

Army Air Corps photos

The evolution of a type. The Curtiss O-1 Falcon of 1924 (above), the O-39 Falcon of 1932 (right). The O-39 Falcon is 50 m.p.h. faster than its eight-year old ancestor

Army Air Corps photo

The DH gets a new lease of life

Lacking brand-new designs giving complete satisfaction, or lacking the money to build them in quantity, the DH-4 was rehabilitated and modernized as a stop-gap. The hazard to the occupants in a crash had already been reduced, and it had been made easier for them to communicate with each other, by interchanging the position of the front cockpit and the main tank. The tank had lain between the two cockpits in the original design, and the observer had to put in a toll call to communicate with the pilot. About 1922, in the interest of safety and of simplified maintenance, some 200 sets of DH wings were equipped with newly-built welded steel fuselages.

The modern era in observation development began when the Army gave up design competitions, forswore "official design" by the Airplane Section of McCook Field, and definitely threw upon the industry the responsibility of proving that they could produce satisfactory observation airplanes. A competition was announced for the fall of 1924, completed planes to be built at the builder's risk and submitted for trial. The recommendation to the competitors was that designs should be accommodated to the Liberty engine, either as the sole power plant or as an alternative to some more modern engine fitting the same mount. Five machines came forward—the first Curtiss Falcon, the original Douglas observation, the Wright Mohawk, a product of the German Henkel Works entered through an American agent, and the government-designed CO-6, all were biplanes, all followed good normal design practice. The quest for miracles, to be achieved by radical innovation, which characterized much of the design of the years immediately after the war was conspicuously absent from the results of the observation competition of 1924. The Wright Mohawk embodied one of the very earliest of the military applications of wing-skin radiators, first tried on racing planes in 1922. The Henkel had quick-detachable wings, with quick-acting fittings on all the bracing wires and with only a single lift wire on each side, the load being carried from the rear truss to the front through the N-shaped interplane struts. The Falcon made the first use of an observation plane of an underslung nose radiator, already on the way to become standard for pursuit ships. It was also marked by extreme stagger, by a swept-back wing for improved vision, and aby a wholly novel type of structure. Welded steel-tube fuselages had at that time become standard practice in America. The Falcon used a fuselage of duralumin tubes assembled into fittings with hollow rivets, which was reported to have saved over 100 lb. in weight in the fuselage structure alone.

There was some vagueness about the outcome. The Army entrant, designed by Mr. Roche of McCook Field, was reported to have given the best all-round satisfaction to the examining board but to have been refused consideration, because of the desire to get new designs from the industry. The Falcon showed the highest maximum performance and was listed as the winner of the competition with a Packard engine installed, but the board felt some concern about the serviceability of so novel a structure. Furthermore, the Liberty engine had been definitely decided on as the standard power plant before orders were placed. Whoever won the competition, the final result was that the big order went to Douglas. Seventy-five Liberty-engined O-2's were purchased together with ten Falcons for service test.

Douglas O2 and Curtiss Falcon

For seven years the development of Army observation material pursued the even tenor established in 1924. Up to the end of the calendar year 1931, 460 Douglas observation biplanes and about 400 Curtiss Falcons had been purchased by the Air Corps as the ultimate outcome of the 1924 competition. The general appearance of the planes did not change very greatly in eight years, but improvements in detail were of course innumerable, and the Liberty engine fell an early victim to the demand for higher performance and greater reliability. The Douglas was switched over from the Liberty to the Wasp, Hornet, and Curtiss Conqueror; the Falcon to the Curtiss D-12 and Conqueror. The improvement in the measurable elements of flight behavior can best be shown in the tabulation below.

The Navy rejects water-cooling

In the meantime, the Navy had been working under a fixed limitation on weight. The first regular service catapults went on to American naval vessels in 1921 and 1922, following almost nine years of experiment in which Commanders H. C. Richardson and T. G. Ellyson played leading parts. Machines used from catapults had to be on floats. The capacity of the original compressed-air catapults limited the maximum gross weight as a seaplane to some 3,500 lb., which appeared ample at the time. At the same time it required that the structure be especially strengthened to stand the catapulting acceleration and the stresses resulting from landings in the open seas. Immediately after the War the Navy had received a considerable number of DH-4's from the Army, and about 1921 had purchased some 100 M-8-0 observation monoplanes from the Loening Company. For catapulting, however, the DH and the M-8-0 and

Improvement, in measurable elements of flight behavior, of the Curtiss Falcon and the Douglas observation plane, as the result of seven years of evolution and several changes of power plant

Airplane	Date	Gross weight	Useful load	Engine and horsepower	Maximum speed	Climb to 10,000 ft (minutes)	Service ceiling
Curtiss O1	1924	4,165	1,600	Curtiss D-12 (440)	143.0	13.1	17,400
Curtiss O39	1931	4,639	1,330	Curtiss Conqueror (600)	173.0	6.0	22,800
Douglas O2	1924	4,705	1,752	Liberty (425)	128.5	21.7	12,300
Douglas O38-E	1931	4,440	1,390	Hornet (525)	149.0	10.6	20,700
Douglas O25-C	1931	4,768	1,330	Curtiss Conqueror (600)	161.0	6.8	21,000

other standard observation types of the time were out of the question

The first answer to the Battle Fleet's prayer was the UO-1, and the UO-1 established the Chance Vought Company as a large factor in the industry. Mr. Vought's first serious attempt on military markets had been made when he delivered the VE-7, a training plane with a 180-hp. Hispano engine, to McCook Field for trial in the early spring of 1918. It was an airplane of beautiful qualities for the time, but the Army's training program was already started and only a very few Voughts were ordered. In 1920 the designer turned to the Navy, and during the next five years sold well over 160 VE's and UO's of various models.

The UO-1 holds a memorable place in the history of naval aviation. It was the first airplane to be put into regular service with the catapult. It was the mainstay of the early aircraft operations on the Langley. It was the first large-scale embodiment of the great decision of the Bureau of Aeronautics to throw the Liberty engine overboard and to insist on modern power plants. With Lieut. Comdr. Bruce G. Leighton, then head of the Aircraft Engine section, furnishing the driving power, the Navy had encouraged Charles L. Lawrance in the development of the radial engines which ultimately became the Wright Whirlwind. The decision was promptly taken to replace all water-cooled power plants with air-cooled ones as far and as quickly as might be possible. It became so far possible in the course of the next six years, that more than 98 per cent of all planes built for the Navy since 1928 have had air-cooled engines.

The air-cooled UO-1, with its 200-hp. engine, thin-wing two-bay biplane truss, and stick-and-wire fuselage, remained the cock of the walk for about four years. There was one deviation from normal in 1924, when 33 three-seat cantilever monoplanes, designed especially for the spotting of gunfire, were obtained from the Martin Company. Like most of the other early attempts at thick-wing monoplanes they ran into unforeseen aerodynamic phenomena, plus some power-plant troubles, and remained in service only a short time. The Martin Company also built a biplane for spotting service, the M20-1.

Enter the Corsair

The next step in evolution came in 1927. The Vought Company was again directly concerned, but it was the introduction of the Wasp engine that really made progress possible. Naval authorities had for some time been conscious of the limitations exacted by a 200-hp. power plant, but their first obligation had been to conform to the conditions imposed by catapult and carrier operations. With a 400-hp. air-cooled engine on the market, it became possible to build it into a two-man plane with full observation equipment within the limit imposed by catapulting. Aside from having higher power, and 30 miles more speed, and the usual wealth of detail improvements growing out of service experience, the Vought Corsair differed from the UO-1 in the use of a welded fuselage and of a materially thicker wing section, permitting the reduction of the interplane bracing from two bays on each side of the fuselage to one. The forward cockpit of the earlier observation biplane had been very hard to get into and out of, especially when wearing a parachute, and the vision of the pilot was seriously restricted. In the Corsair the upper wing was swept back to overcome those difficulties, and the vision upward and forward was notably improved. In later models it was still further improved by cutting the rear spar and bending it forward in the center section to give a K-shaped truss in the plane of the upper wing. The trailing edge of the upper wing could then be cut forward more than 50 per cent of the chord, in place of the 25 per cent cut-out available on conventional biplanes with a straight rear spar.

Marine Corps observation partakes both of Army and Navy characteristics. The Marines in Nicaragua and elsewhere have made good use of many Corsairs and more recently have been purchasers of the Curtiss Helldiver, an indirect descendant of the Falcon, having an air-cooled engine and of somewhat smaller dimensions than its progenitor. The Marine service demands a combination of observation, attack, light bombardment, and fighting airplane, especially the first three. The Helldiver was tailored to those specifications.

Mechanical ducks

The specialized problem of the amphibion observation airplane has been of interest both to the Army and the Navy. The reason for the Navy's interest is obvious, since airplanes must rise from the deck of the carrier and fly for hours over the open sea. Furthermore, it is often desirable to take off from a carrier deck and fly ashore, landing in a harbor when no convenient flying field is available, or to catapult a plane from a battleship and land it, at will, either on the water or on the deck of a carrier for refueling. The Army has required amphibions for general utility service, for rescue work, and to meet special operating problems arising in Hawaii, Panama, and the Philippines.

Experiments in amphibion design had

Army Air Corps

U. S. Navy

Army Air Corps

Army Air Corps

Monoplanes old and monoplanes new. The corrugated duralumin-covered CO-1 (top) built at McCook Field in 1921, the MO-1 (above, left), furnished to the Navy by Glenn Martin in 1923, the Douglas YO-31 (above), just now going into production and notable for high speed and vision; General Aviation 0-27 (left) a strictly modern long distance observation plane with twin Conqueror engines and retractable landing gear.

U. S. Navy photos

Observation planes for catapults and carriers. The VE-9 (top, left), with Hispano engine, of around 1922, its air-cooled sister, the Vought UO-1 (top, right), the standby of of early fleet aviation; its successor the Corsair, in amphibion form (left); the Curtiss entry in naval observation, the 1930 Helldiver (lower left).

experimenting with the operation of water-cooled engines in the inverted position, to improve forward vision for the pilot. Several European countries had been working on the same lines. To Grover Loening goes the credit for realizing that the inverted installation made it possible to build an amphibion far more compactly, especially on its vertical dimensions, than anyone had previously dreamed. The Army received its first Loening observation plane, the COA-1, in 1924.

been made as early as 1912. In 1922 the Navy Department announced a competition for the design of "ship planes," seaplanes capable of taking off from the deck of a vessel. The prizes were on a generous scale, and some 30 entries were received. The principal award went to the Dayton-Wright Company, for a float seaplane with wheels retracted by swinging upwards and outwards in the manner of many later amphibions. The plane was adjudged heavy and clumsy, and only one was built, but it was a pioneer in the field and set men's minds dwelling on the amphibion as a possibility.

The next step was taken in the industry, and first supported by the Army. The Air Corps had for some time been

The Navy soon followed suit in purchasing some Packard-engined Loening amphibions, but by the end of 1925 the Army had six machines from that plant and the Navy only four. Soon thereafter orders began to be placed in considerably larger numbers, and by the end of 1927 there were 28 amphibions in the Army and 37 in the Navy. About that point the practices of the two services diverged, the Army continued with inverted water-cooled engines for amphibion service, while the Navy surrendered the advantages that the inverted installation could offer in compactness and in forward vision in order to secure those considered to be inherent in the radial air-cooled engine. The delivery of the first Wasp-engined amphibion was followed during the next three years by the order of 55 of the type, the naval usefulness of which was considerably increased by the development of gunpowder catapults of a larger capacity than the compressed-air catapults previously used. About 1927, therefore, it became possible to catapult amphibions from the capital ships of the battle fleet, in addition to using them from the carriers.

Trends in observation design

The historical review has brought the observation equipment of the Army and the Navy down to the Douglas O-25C

Specialized amphibions. The Navy's first amphibion experiment—circa 1913—(left); the first Loening amphibion to go into Army service—1924—(below, left); the Keystone Loening product breaks away from water-cooling—the OL-9 of 1929—(below).

Army Air Corps

U. S. Navy

and O-38B, the Curtiss O-39 and O-1G the Vought Corsair O3U-2, and the latest models of the Keystone Loening amphibion Taken all together, these types account for something over 80 per cent of the present observation equipment of the Army and Navy To get a fair idea of present design tendencies and of the existing preferences of the Army and Navy, however, something must be said of more recent events

For a long time, both the Army and Navy have been standardized on externally-braced observation biplanes with welded steel tube fuselages, wooden wing structures, and conventional tail surfaces and landing gears There have been no such radical innovations in America as the single steel girder tail-boom of the Breguet 27 and most recent Potez Within the past two or three years, however, experiment has begun to play about with all-duralumin fuselages, with metal wing structures, and with monoplanes

Metal wing structures and duralumin fuselages made their re-appearance with an Army order to the Thomas-Morse Company in 1925 for a group of observation planes, based in general upon the Douglas design but with wood replaced by metal, in accordance with a system of construction which had been under development by the manufacturers for several years The Thomas-Morse machines subsequently developed into a distinctive type, with a fuselage having a skin of corrugated dural applied over a framework of slotted circumferential tubes, and notable for having the simplest metal wing spars ever devised—extruded duralumin I-beams with bulb flanges A total of 174 of them, mostly of the O-19 type has been delivered by the Thomas Morse Company, now a subsidiary of the Consolidated Aircraft Corporation within the past three years

More recent designs for the Army follow the general swing imposed by Air Corps demand on the development of planes for all purposes, towards smooth-skinned dural monocoque fuselages, duralumin spars, and movable enclosures over the cockpits

Much pioneering work on all-metal construction was done by the Navy immediately after the War, especially in the building of an all-metal observation plane at the Naval Aircraft Factory in 1922 The Navy's more recent work in metal construction has centered in experimental development by the Vought Company on Corsairs with duralumin fuselages and with steel and duralumin wing spars and in some extremely interesting studies by Berliner-Joyce The latter, however, have been concerned more with fighters than with observation planes B J are now constructing eighteen observation planes for the Navy

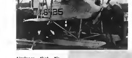
Monoplanes for a look below

It is most remarkable that monoplanes have not been more commonly used for observation Obviously, the machine's whole function depends on getting a clear view of the ground, but very few designers, either in America or in Great Britain have attempted to provide a clear view by eliminating the greatest of all obstructions to vision the lower wing The Army and the Navy each made some experiments with high-wing monoplanas in the early days, but the CO-1 and NO-1, the Martin MO-1, and the Loening M-8-O passed and left no direct descendants The first orders for observation monoplanes since 1925 were placed in 1931 In that last eighteen months the Army has ordered for service test eleven Douglas corps observation monoplanes with dural monocoque fuselages and "gull wings" Orders have also been placed for seventeen long-distance, or "Army," observation monoplanes All the latter group are twin-engined all are three-seaters all have retractable landing gears Twelve are being built by General Aviation, five by Dougles Whether or not the monoplane will make great gains in popularity at the expense of the biplane, and be the subject of future production orders is not yet apparent but at least it seems to have an excellent chance A sesqui-plane with an extremely small lower wing is another possibility The general trends of design, in almost all categories and in almost all countries, have been distinctly towards the cantilever or semi-cantilever monoplane in the last four years, and the factor of vision gives the monoplane a special advantage for observation work The new monoplanes now in course of development offer remarkable improvements in performance over any previously available, but of course that is due quite as much to increased power and to a general cleaning up of structure as to the adoption of the monoplane form In testifying on the current Army appropriation bill, General Foulois said that the two-engined observation planes to be bought during the next year were to have a speed of approximately 178 m.p.h., while three different single-engined models would show approximately 182, 187, and 220 m p.h

The monoplane might gain the day in the Army and still find no place in naval operations, for the Navy has the special problem of compactness of dimension Roughly speaking, and other things being equal, to increase the span of a naval airplane by 1 ft means to decrease by three or four the number of planes that can be housed on board of a carrier, and to make a like sacrifice in the number that can be parked on the forward part of the deck ready for immediate action The same problem of the preciousness of space arises on the ship equipped with catapults, and the monoplane almost inevitably has at least 3 or 4 ft more span than the corresponding biplane The extended adoption of monoplanes on shipboard obviously presents some special difficulties Other things are not always equal, however, and there is a school of opinion which holds that high-wing monoplanes can actually be stored more compactly than biplanes because of the possibility of staggering rows of planes and letting the tails of the machines in one row run back under the wings of those immediately behind—an impossible expedient where there is a lower wing

The current development of amphibion planes has been governed largely by the requirements of service with the fleet The amphibion in the Air Corps being largely of a general utility type, commercial designs have been more directly applicable there than in the naval service, and the Army has recently bought ten Douglas Dolphins, essentially identical with the commercial Douglas amphibion in design The Navy has been working along two lines On the one hand specialized amphibion biplanes built as such from the ground up like the original Loenings, are under development by the Loening, Great Lakes Sikorsky, and Grumman companies In

U. S. Navy



U. S. Navy

Airplanes that aismantle and submerge. The Martin submarine biplane — 1922 — (above); the only recent contribution to submarine aviation, the 1931 Loening (right).

addition to that there have been a number of purchases of amphibion gears for Vought Corsairs, making the amphibion a third modification of the standard observation plane already able to function as a landplane or seaplane at will An amphibion gear which can be added at discretion reduces the hazards of over-sea operation, fits the machine for rescue work and for certain specialized operations, such as have already been mentioned in connection with the original introductions of the first Loening, and pays for those advantages in increased weight and decreased performance The standard amphibion Corsair is 5.8 m.p.h slower than the float seaplane of the same type, and has a service ceiling 400 ft lower As compared with the land plane Corsair, its deficiencies are 9.1 m.p.h., and 1,100 ft of ceiling.

There remains one highly specialized type of observation, which must be considered wholly as a modern trend It disappeared from view and apparently from service policy almost ten years ago, and has only very recently cropped up again The airplane has gone back into the submarine service

Sub-surface airplanes

Plenty of experiments with quick folding seaplanes of miniature dimensions, for storage in a water-tight casing on the deck of a submarine, were tried during and just after the war Heinkel in Germany, Short in England, and Martin and Loening in the United States all ventured in the field The idea of developing such a plane was soon abandoned, principally because of the lack of very large submarines and of very small airplane engines With the construction of the V-class submarine, of some 2,000 tons displacement, in the United States, and the M and X classes of even larger tonnage in Great Britain, and with the production of good commercial airplane engines of under 125 hp., the submarine airplane became again a live subject The first result is the Loening miniature monoplane flying boat with the wing across the top of the hull and a 110-hp engine, a wing loading of 10.6 lb per sq.ft., and a maximum speed of 101 m.p.h The wings fold back along the side of the hull and allow the craft to be stowed in a compact cylindrical tank The machine has not yet been ordered for regular production, and the practical use of airplanes with the submarine squadrons remains highly experimental The fundamental idea differs from that of the Heinkel, most fully developed and extensively used of previous submarine planes, for the Heinkel was a cantilever float biplane with quickly detachable wings and floats

The evolution of pursuit, bombardment, and other types will be coverrd in articles to appear in AVIATION *for July and subsequent months*

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Subsidizing the short feeder line

By
Gordon K. Berry
Newhouse Air Service

CHAMBERS of Commerce or other local civic organizations may with profit to their communities undertake the promotion of semi local airlines even as they have backed airport developments in recent years These semi-local airlines would be in the nature of feeders about which much was said in the early days of the contract air mail system They would link neighboring cities, serve as the air outlet of a definite area and hook up with the trunk air mail or and trunk passenger lines now crisscrossing the country

Many an airport was built on the expectation that it would soon be included on some airline active or proposed There has been much disappointment, though it does not follow that an airport is only partly useful when not served by an airline. The main airline system obviously cannot include every port where lines have been expected or invited, and, anyway, operators of these lines are interested primarily in developing their part of a huge system. The needs of the smaller communities whether on or off the beaten track have not been objects of their immediate concern It does follow, however, that in many cases communities wishing airline accommodations must do some promoting themselves or they are liable to be without such facilities for some time.

Here is where Chambers of Commerce may again put their shoulders to the wheel in a community development. this time in cooperation with other cities in the same area Such an undertaking is aided by the existance throughout the country of scores of planes suitable for just such feeder lines. They are in the hands of the operators of many average airports and are in use so little that they are a burden to their owners While these are collecting dust, or shedding dust only infrequently on various miscellaneous and occasional missions, they may very well be employed to try out a promising idea Furthermore, many of these operators, often the only local flying company, need some such extra encouragement to help keep them in business

The planes are single-engined craft of about four or six passenger capacity. They may be operated economically and serve the purpose for feeder services until larger equipment is required by traffic volume. On a line of 200 miles each round trip would cost in the neighborhood of $50, including its share of the pilot's salary, depreciation, insurance, hangar rental and maintenance. With patronage of air passenger and express facilities growing, the risk to a group of 40 or 50 collective backers, such as a Chamber of Commerce could provide, would not be unreasonable when the undertaking is based on an expert survey With the experience in airline operation in recent years, a competent survey should be a reliable indication of the project's prospects Use of single-engined craft for scheduled transportation has been gaining popularity in the present trend toward improved operating economy, some of the larger companies are adopting the type for certain runs

What risks are involved might well be assumed in view of the obvious advantage such feeders would provide the communities linked Further support to the idea might be aroused by arranging preference or special concessions for the backers in securing passenger tickets or space allotments for express, as at least part compensation for their support Local trucking companies, for instance, might be interested because of the express business In any event the investment involved need not nearly approximate that freely allotted to airport projects in the past

A number of airline projects afford lessons to be applied in application of the above proposals One is that of the New England & Western Air Transportation Company which in 1930 operated in New England, a section which could benefit tremendously by such feeder lines This company was forced to halt operation when patronage failed to justify operation of tri-engined equipment over the short distances covered It did not carry mail or express and the few passengers did not provide a sufficient income, though they might very well have supported single engined equipment.

The conspicuous record of the Ludington line connecting Washington, Baltimore, Philadelphia, Trenton and Newark (New York City) without either chamber of commerce or mail contract support in financing offers an encouraging example of what may be done.

¶ Beginning a series of articles on airline servicing and overhaul—the result of a country-wide tour of maintenance shops by a member of the editorial staff of AVIATION. In the course of a four weeks' trip, covering about 7,000 miles, ten major overhaul centers were visited. The articles which follow will be devoted to detailed discussion of plants and methods. The present article deals with some broad observations and general impressions of the picture as a whole.

The old idea was for each operator to consider his methods superior to those of his rivals, and to keep them a deep and dark secret to be jealously guarded against possible adoption by the others.

Drydocks for airliners

By S. Paul Johnston
Assistant Editor of AVIATION

EVERY industry that has its beginning in a more or less simultaneous development of a group of widely separated units, goes through at least two distinct stages before it attains its real majority. The first might be called the development stage, where each unit works independently on problems more or less common to all, solving them in its own particular fashion. The tendency under such circumstances is for each operator to consider his methods superior to those of his rivals, and to keep them a deep and dark secret to be jealously guarded against possible adoption by the others. The shift to the second stage occurs when individuals realize that ideas other than their own may be meritorious, and that a more or less free interchange of ideas offers distinct economic advantage to all.

Air transportation, as a business, is gradually passing out of the first stage and now stands on the threshhold of the second. Not only have many small operations merged into great transcontinental trunk lines, each contributing its share of knowledge to the unified system, but the larger companies are now finding it profitable to discuss their problems openly, thus pooling their accumulated experience. The need for acquiring information more or less surreptitiously has practically passed.

Of all the departments in the complicated structure of the average air transport organization today, the maintenance and overhaul functions offer perhaps the most fertile field for improvement from the free interchange of ideas. The shops of the major lines are widely separated geographically, and have little or no direct contact with each other. Traffic and operations men of various lines have frequent opportunities to meet, but the men who have charge of the shops seldom get an opportunity to sit down together to talk things over. Steps have already been taken to bring to the attention of airplane designers some of the problems which waste time for the men who must take care of the machines they produce, but it is of equal, if not greater importance, that maintenance people get together to agree upon their requirements, and to set up a definite set of standards against which designers may work. Ralph G. Lockwood, in the January and February issues of AVIATION, made a notable advance in this direction with the publication of a set of maintenance standards for design for a number of airplane classifications.

Uniform accounting needed

It is obvious that the only basis on which to compare specific methods for maintenance is economic. The only logical criterion, assuming results yield reasonably comparable factors of safety and reliability, is whether one costs more or less than another in dollars and cents. At the present time it is very difficult to make any direct comparisons, for operators are very reluctant to open their books and discuss costs, although there has been some tendency among large operators to express a willingness to put their cards on the table if they could only be assured that others would do likewise. Perhaps the time is not far distant when such a state of affairs can be brought about. When it does come, however, it will be essential that a standardized and comparable system of accounting be used by everyone if a direct comparison of unit costs is to have any real meaning. The standardized system required by the Post Office Department, although no doubt admirable for postal purposes, falls far short of filling the bill for comparative maintenance studies.

In dealing with the general problem of the upkeep of aircraft a uniform terminology would avoid a certain degree of confusion which now exists. In this and in subsequent articles on the subject, the term "maintenance" will be used to describe in a general way the whole group of operations carried out to keep airplanes and engines in shape to fly. The term includes, therefore, the two subordinate functions of "servicing" and "overhaul." Servicing includes all those daily and other periodic operations done to enable the equipment to complete schedules. It covers refueling, oiling, greasing, cleaning and similar operations, as well as routine inspection and check on both airplane and engines. Overhaul, on the other hand, involves by definition a complete tear-down of equipment.

Organization for maintenance

The direct responsibility for maintenance usually rests with one individual, variously known as chief engineer, division engineer, or superintendent of maintenance, who is directly responsible to the operations manager of the line or the division. Maintenance functions, therefore, occupy a position on the organization chart parallel and on the same level with traffic, operations, and, in some cases, communications. The general maintenance department is further sub-divided into the two functions of servicing and overhaul, as defined above. The servicing foremen at all outlying stations along a line or division are usually directly responsible to the maintenance department head.

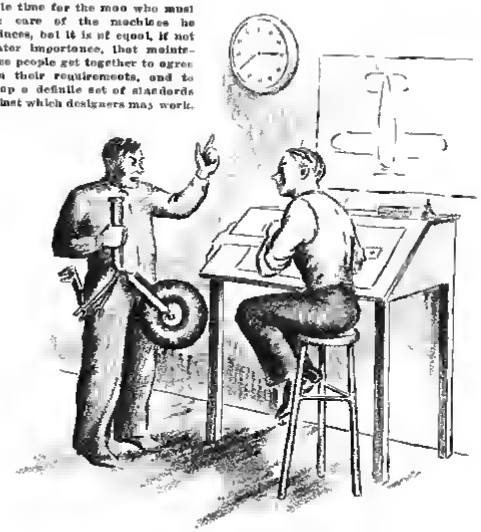
In cases where an airway system is made up of two or more divisions, there is usually a remotely-located central organization which includes a chief engineer whose primary purpose is to coordinate and standardize methods and equipment among all the divisions. For administrative purposes, the heads of the outlying maintenance departments report directly to their division or line superintendent, but for information and advice of a purely technical nature they are kept in direct contact with the office and staff of the central chief engineer.

Inspection methods vary somewhat among the different lines. Some shops assign individuals from the servicing or overhaul crews to check over airplane and engines and report on their conditions. The inspecting mechanic must follow a definite form, and must initial each item inspected, thus assuming full responsibility for its condition. It is argued that a man who is a capable mechanic and who is actually accustomed to doing repair work on airplanes or engines is much more familiar with parts or places where trouble is likely to occur than anyone else can be. The general trend, however, seems to be toward the setting up of a separate inspection crew, entirely independent of either maintenance or overhaul shop, and responsible only to the engineer or superintendent in charge of maintenance. Assuming that men can be obtained who have served their time as mechanics, the independent inspection system offers the advantage of a complete double-check on all work, and a reduction in the possibilities of any defect getting by without detection.

Shop layout

In making broad comparison of the shop facilities of the several airlines, one fact stands out clearly. Most of them have decidedly outgrown their present quarters. With the increasing demand of growing services, and with a steady increase in overall dimensions of the airplane being used, many original shop facilities have had to be expanded, largely by the addition of leantos on original buildings or by moving certain shops out of hangars into temporary structures nearby. In a period of rapid expansion, especially with general business conditions as they have been in the past three years, most of the operators have not felt justified in spending money for new shops, particularly since opinion is still somewhat unsettled as to what form the transport flying equipment of the near future is going to take. Operators naturally hesitate to tie up capital in buildings or in locations which may become quite obsolete in a relatively short time. None the less, although the airline overhaul shops are in many cases working under conditions which are far from ideal, they are all doing a very creditable job. In no case is it apparent that the quality of their work is allowed to suffer due to the inconveniences of physical layouts.

Fortunately, there is plenty of evidence in sight that the hit-or-miss development of the past is at an end, and that airline officials are now applying logical engineering methods in selecting locations for their plants, and laying them out with an intelligent understanding of modern industrial practice. Not only have the experiences of the past two or three years made their own requirements clear to them, but they are beginning to recognize that the overhaul of airplanes has a great deal in common with factory methods of long standing in other industries. One or two shops have already been built, and several more are now being planned, in which the relationship of various departments and the continuity of flow, both of material and operation, has been studied from an engineering viewpoint. Considerable encouragement may be derived from the fact that intelligent use is now being made of available data in planning for the future.



Steps have been taken to bring to the attention of the airplane designer some of the problems which waste time for the men who must take care of the machines he produces, but it is of equal, if not greater importance, that maintenance people get together to agree upon their requirements, and to set up a definite set of standards against which designers may work.

A great deal of consideration is being given not only to the detailed arrangement of shop equipment, but also the problem of the best location of overhaul shops with respect to the territory covered by the line. The question is not particularly serious on a line operating a large number of schedules over relatively short distances. In this case the flying equipment passes through any given place on the line two or three times a day, and the question of location of shop may depend entirely on where working space or labor may be obtained most economically. Long-distance operations, however, require more careful consideration, for schedules must be so laid out, and the flying equipment so distributed around the system, that planes and engines may be brought to a repair base at regular intervals for inspection, maintenance, and overhaul. Some of the transcontinental lines, in the process of merger, have acquired existing shops installed to take care of

the equipment of the shorter lines. There is a marked tendency at the moment, however, to shut down these divisional maintenance centers and to consolidate equipment and personnel at a location near the geographical center of the system.

Due to the wide diversity of airplane types used on the major airlines it is rather difficult to draw any close comparison among the various methods of airplane overhaul. Conditions vary so widely, not only with the type of equipment, but also with the conditions under which it is used, that the major problems of one repair shop are almost unknown in others. This is true not only among airway systems, but also among divisions of the same system.

Effect of airplane types

The type of airplane used has a great influence on the equipment and set-up of the overhaul shop. Lines operating entirely with all-metal airplanes obviously have very little use for woodworking, fabric or doping equipment, but must have very extensive facilities for working in sheet metal. Few if any lines exist today, however, that have attained this degree of specialization. Practically every airline still owns and operates over short runs or for emergency schedules airplanes of mixed construction, that is, machines involving steel tubing, wooden members, fabric coverings, and sheet metal cowlings and fairings. It is necessary, therefore, that most airplane overhaul stations be fully equipped to handle all such materials. The proportion of the total shop floor space given over to sheet-metal working, wood, welding, fabric and dope shops, is therefore directly dependent upon the relative amounts of these materials in the airplanes which must be maintained. Even in places where metal equipment has practically replaced that of composite construction, new work will often be found to justify the retention of shops which might otherwise have to be abandoned. For example, wood shops which formerly were kept busy rebuilding and recovering all-wooden wings are now found useful in repairing and replacing interior cabin trim and paneling.

Routine servicing and overhaul schedules for airplanes vary again with the type of equipment and the conditions under which it is used. As a general thing, however, airplanes are thoroughly checked and inspected at every overnight stopping point. The period for more thorough checking varies somewhat with the length of the line and the arrangement of schedule, but it is general practice to hold all airplanes over for at least one day in the repair base at the end of every 20 to 30 hours of flying for a thorough going-over. The work done at this period usually does not involve any extensive dismantling of structure. For planes with fabric coverings on fuselage or wings, it is general practice to give them a complete tear-down and overhaul after about 1,000 to 1,500 hours of service. Overhaul schedules for metal covered planes are far from standardized, and apparently vary rather widely. At one shop, at least, all-metal airplanes are given a rather extensive tear-down at every period of engine overhaul, or approximately at every 375 hours of flying, although the general average is much higher.

Engine overhaul

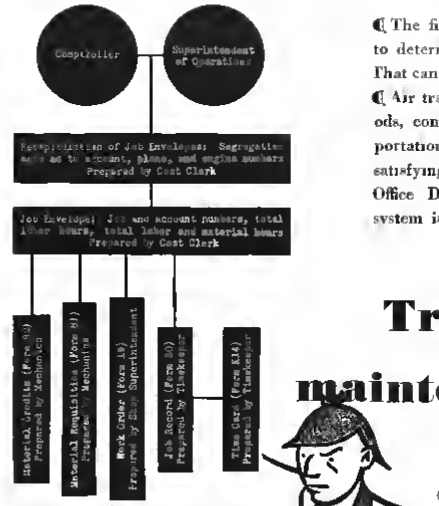
The variations which exist from shop to shop in methods of airplane overhaul are much less marked in the case of engines. This is only natural for with one exception all lines are using radial air-cooled power plants, and three manufacturers supply virtually all the engines in transport use today. One engine is very much like any other regardless of make, and the manufacturers have worked out standardized overhaul procedures which compare closely. Through their field service departments, the engine makers have rendered valuable assistance to the operators in setting up and organizing their overhaul shops. Some variations occur in minor practices, of course, but taken as a whole, there is an apparent uniformity in handling engines.

Over the past few years there has been a marked tendency toward increasing the number of flying hours between engine overhaul. It has not been long since 200 hours was considered the maximum length of service between tear-downs, but with constantly improving materials and design, and with a rapidly accumulating mass of operating statistics available, overhaul schedules have been pushed from the original 200 to 250, to 300, and now, although manufacturers still recommend 300 hours as the proper period, some airlines are finding that it is economical to operate engines to about 350 hours. The exact time schedule within this range depends more on economic than on safety considerations. Records indicate that any engine which has been given careful attention will operate without danger of stoppage well beyond the 300-hour mark, but it is a question of balancing out the cost of labor and materials on shorter or longer schedules. It appears to be more profitable, at the moment, to tear down between 300 and 350 hours, rather than to try to run longer periods and take the risk of more extensive parts replacement when overhaul finally becomes necessary.

Under present operating conditions, most engine shops are being called upon to turn out from three to six engines per week. It usually takes from a week to ten days for any given engine to pass through the shop, from tear-down to and including run-in. As outlined above, it is frequently difficult to gain access to the actual time cost records but from what little data are available, it would appear that the average engine overhaul labor time (for a nine-cylinder radial, air cooled engine of virtually any make) is about 125 to 130 man-hours. Depending on the amount of work to be done which again is a function of the general condition of the engine, the extreme range may be from 115 to 150 man-hours. Again, it is encouraging to note that the trend is toward the lower limit, and it is to be expected that continual improvement in this direction will result both from the manufacturer supplying better materials in his engine and from the shops developing more efficient overhaul methods.

Perhaps the most marked difference among the various engine shops lies in the method of organizing the crews. One or two shops still retain the crew overhaul method where an engine is turned over complete to a mechanic and his helper to do all the work from tear-down to re-assembly. One crew becomes entirely responsible for the functioning of the engine. The general trend of shop organization, however, is decidedly away from this method. By far the majority of engine shops are now organized on a strictly production basis where the parts move progressively from station to station through the shops, each man in the crew performing a special operation, and being fully responsible for a particular part of every engine. While this method removes the factor of the personal interest of a particular crew in a particular engine, it undoubtedly makes for economy where a relatively large number of engines are being handled, and furthermore, it tends to create uniformity in engines which probably can not be matched by the individual crew system. Again extensive data are lacking, but it seems quite probable from what little information is available that the total labor hours will be somewhat less in a shop properly organized along production lines. As the volume of engines in use increases, the superiority of the latter system over the individual-crew method would become more and more apparent.

The overhaul of accessories such as propellers, instruments, batteries, etc., has also attained a certain degree of uniformity among all lines. Again, as in the case of power plants, the manufacturers of such equipment have rendered valuable assistance to operators through adequate cooperation in the field. Many interesting variations in detail occur, however, whose treatment is somewhat beyond the scope of the present article. In the series of articles which follow, the shops and methods of a number of the larger airlines will be described and discussed individually at some length, and the points of similarity and of difference will be described in more detail.



Western Air's maintenance cost accounting procedure

¶ The first step in reducing maintenance costs is to determine them to a high degree of accuracy. That can be accomplished only through accounting. ¶ Air transport demands unique accounting methods, combining features of industrial and transportation accounting and, for mail contractors, satisfying the exacting requirements of the Post Office Department. An unusual and effective system is presented in the accompanying article

Tracking down maintenance expenses

By L. H. Dwerlkotte
Chief Accountant Western Air Express

AVIATION as a new industry, has required the development of new methods of accounting. Some companies have experienced grave difficulties because their accounting systems have failed to yield accurate information as to detailed costs. With this difficulty fully in mind, Western Air Express has developed a system of cost accounting that differs materially from those common to other industries, and departs in several respects from practices common to the aviation industry.

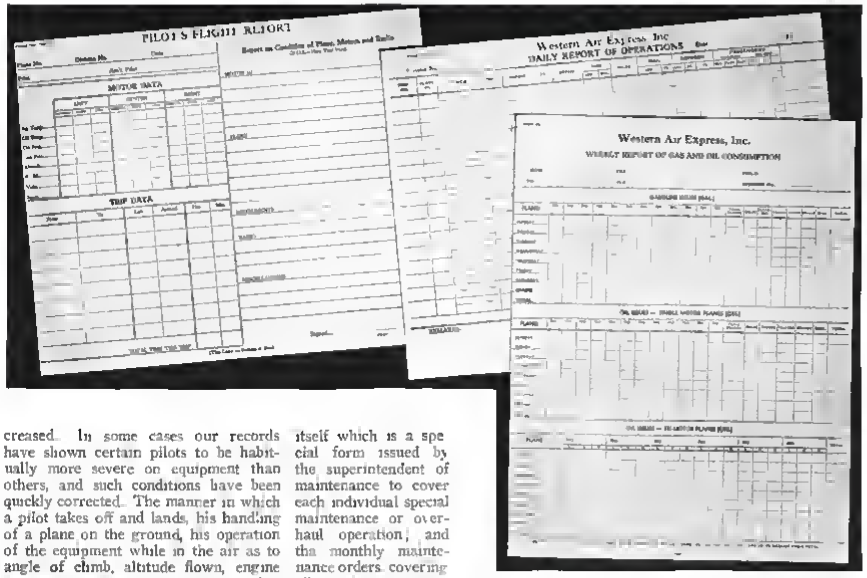
The personnel of our field accounting department at the present time includes eight people half of whom are located at Denver, Colo., and the other half at Burbank, Cal., where stockrooms and repair shops are maintained. They do all maintenance cost accounting for an operation with sixteen planes in active service, ranging in size from single-engined Boeing mail planes to tri-engined F-10 Fokkers, and flying an average of 3,732 miles daily over 1 866 miles of route stretching from San Diego, Cal., to Salt Lake City, Utah; Cheyenne, Wyo., to Amarillo, Tex., and Pueblo Colo., to El Paso, Tex. There are seventeen pilots and a mechanical ground crew of 35 men normally employed in connection with these operations.

In general, Western Air Express' system combines selected features of industrial and of transportation accounting. One of the chief differences between an airline system and that of an ordinary transportion company is that many of our maintenance operations are of a non-standardized sort, requiring special attention in each case. Although all standard engine parts are regularly stocked, it is not practicable to keep on hand a complete supply of replacement parts for a large transport plane. Thus many operations in connection with maintenance and overhaul of planes require the construction of complete plane parts or units. For such work it is necessary in every case to set up a separate "job order," specifying all work to be done and materials to be used. Such a procedure makes the problem of maintenance accounting for an air transportation operator more complex than it would be otherwise.

Another way in which our system of maintenance cost accounting differs from ordinary transportation accounting, and from the practice of some air transport operators, is our manner of charging depreciation on equipment. Instead of writing off plane and engine on the basis of months or years in service, we set up a figure based on the number of flying hours of service for each unit. Western Air has found this method most equitable, maintenance costs being charged against equipment only while it is actually in operation and bringing in revenue. On the monthly depreciation basis a plane might lie idle for some time, piling up depreciation charges on the books without actually depreciating measurably and without bringing in any revenue to offset such charges. The foundation for our method of charging depreciation is our practice of keeping planes in the air as much as possible, making service in the air rather than time on the ground the actual measure of each plane's life.

A specialized accounting system designed to give us all pertinent data has made it possible to assist the mechanical department materially in steadily lowering maintenance costs, while at the same time materially improving standards of maintenance. Through careful inspection of maintenance records kept by the accounting department, the mechanical staff is able to prolong the life of equipment appreciably.

Perhaps the outstanding contribution to lowered maintenance costs is in the check constantly made upon all pilots. Records are so kept that the performance of various pilots with the same plane, and of various planes under the same pilot, is easily determined. It has been found that the pilot is a major factor in maintenance costs, and by means of this cross check it has been possible to instruct pilots in such a way that certain costs have been much de-



The pilot's flight report is checked at the end of each trip by the maintenance department and a record of any repairs is made on its reverse side. The daily report of operations is kept by the dispatcher. The report of gas and oil consumption is kept in duplicate at each regular servicing point and the original, signed by the field manager is forwarded to the accounting department

creased. In some cases our records have shown certain pilots to be habitually more severe on equipment than others, and such conditions have been quickly corrected. The manner in which a pilot takes off and lands, his handling of a plane on the ground, his operation of the equipment while in the air as to angle of climb, altitude flown, engine r.p.m., operating temperature, carburetor adjustment, and other factors all contribute in some way to maintenance costs. It is possible to check most faults of operation through a study of the complete maintenance and operating records.

The system in detail

The Western Air Express accounting system, in common with those of other air mail operators, must serve a dual purpose in that it gives all necessary information for proper maintenance and charging of maintenance costs, in addition to all information required by the Post Office Department as to operating and maintenance costs.

The primary forms upon which all maintenance accounting information is recorded include: the operations reports, covering operation of all planes and compiled daily in the dispatcher's office; the pilot's flight report kept by the pilot or co-pilot; the fuel service record, kept at all fueling points by the manager in charge of the field; the mechanic's time card, which gives all labor time by plane, engine, or job order; the material requisition, prepared by mechanics and approved by the shop foreman, requesting storekeeper to deliver required parts to mechanics, and which lists all materials or parts drawn from stores or turned in for credit; the condemned, repairable, or serviceable tags which are used on all parts taken from service to designate their condition; the work order itself which is a special form issued by the superintendent of maintenance to cover each individual special maintenance or overhaul operation; and the monthly maintenance orders covering all routine inspection and maintenance.

These various forms are all turned in to the accounting department, and the information they contain is used in compiling the maintenance cost records which include the monthly summary sheet giving a cross check on operations of planes and pilots, log of the plane, log of the engine, job record sheet, covering each special maintenance job, stores record, showing movements of parts and materials and where chargeable, the monthly job record report, covering all mechanical work done each month in a break-down of charges to various individual accounts; and the pilot's pay voucher, which gives an accurate record of each pilot's time in each plane he has flown during the month.

The system is set up to show the costs by operating divisions. Costs are also broken down to show the amount chargeable to each engine and plane and to each individual maintenance account. Our operations are at the present time segregated into two routes, or divisions, and all costs are totalled by these divisions. Form 112, the dispatcher's daily operations report, is the basis for determining all average maintenance costs per mile and hour of operation. It is kept for each division separately and shows planes, operation, by what pilots, between what points time of flight, number of ground miles flown, loads carried and other special information. The pilot's flight report, form 105a, is the source of information on pilot's mileage pay, gives flying and arrival and departure times. Other information on this report covers engine data with respect to air and oil temperatures, fuel and oil pressures, altitude, engine r.p.m., and the generator charging rate. It also contains the pilot's comments on the general condition of the plane, engines and radio as well as gallons of fuel and oil consumed. It is kept by the pilot or co-pilot, and is signed by the pilot. The original copy stays with the plane, and a duplicate is forwarded to the accounting department. At the end of each trip this report is carefully checked by the maintenance department, any defects noted by the pilot are corrected and a record made on the back side of the report of all work done, repairs made and parts replaced. As the original report is kept in the plane in book form, the maintenance department has at all times a history of the performance of the plane, engines and radio. Both of these forms, 112 and 105a, also supply payroll and

statistical information. A fuel service record is kept in duplicate at each regular servicing point and lists all fuel and oil serviced to planes, sales and the quantity issued to each pilot. This form (150) is signed by the field manager, the original being forwarded to the accounting office at the close of each week. There it is checked against the pilot's flight record and the information is then entered on the log re capitulation sheet for the proper plane, engine and pilot. A report is made to the superintendent of operations at the end of each month, giving all fuel and oil data as a check against unusual engine conditions. Also, he is furnished with a report showing the average per hour fuel and oil consumption of each pilot in different types of planes. This comparative record enables him to eliminate any excess fuel consumption.

Separate log sheets, forms 106 and 107, are kept on each plane and engine. These are made up from the pilot's flight reports which are sure to be prepared in a careful and accurate manner by the pilots since it is the record from which their mileage pay is compiled.

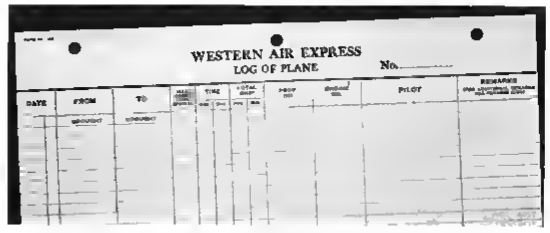
The plane log sheet carries information day by day on the total time of the plane, points between which flown, type of flight, propeller and engine number, pilot making the flight, hours since last overhaul, and general remarks. The engine log sheet is about the same and in addition shows detailed information on the fuel and oil consumption, oil pressure and temperature, and data on the air temperature, air speed, and altitude flown. The flying time shown on the logs is used in compiling monthly depreciation charges. Each log sheet covers a period of one month.

General routine

Routine maintenance is covered by monthly job orders made up and attached to form 19, which is merely a brief instruction sheet giving the job number and general work to be done as authorized by the shop superintendent. One order is issued each month for every plane and engine covering general routine inspection and maintenance work. A set of detailed inspection sheets is used, of course, in connection with all routine maintenance. If major overhaul work is performed, on planes, a separate order is issued for each operation of repair work on the various plane units, such as: wings, fuselage and nacelles, empennage, cabin, pilot's cockpit, instruments and instrument panel, propellers, fuel and electric systems, cowling and collector rings, controls, landing gear and radio. By preparing and keeping detailed costs on the repair or replacement of the above items the maintenance department can readily furnish estimated costs for contemplated repairs and determine whether it would be profitable to make them. In connection with these major overhauls all material and labor costs are compiled by operations as shown on the mechanic's time card, form 140, and the stores charge or credit sheets, form 81 and 82. Each mechanic checks in and out on the time clock opposite each job number on his time card, as the work progresses, and the timekeeper then totals the information on these cards to show the mechanic's time on each separate operation of a given job. This latter information is kept on form 80, one sheet of which is kept for each job and upon which is recorded the work done by each mechanic, giving the date of the work and the hours and minutes chargeable to that job on that day. The time cards also are used by the payroll auditor in computing wages due mechanics.

The stores charge and credit sheets, forms 81 and 82, are kept by the storekeeper, who charges all materials to the jobs for which they were issued, or to credit parts taken in to the job from which the parts were taken. Materials are issued by the storekeeper to mechanics only upon presentation of material requisition form 81, properly signed by the shop foreman.

When a part is removed from a plane or engine, and judged worn out or broken beyond repair it is marked with a red tag labelled "condemned," form 169, and information on the part, place from which it was taken, its total life and reason for failure is listed and recorded before the part is discarded. Parts or units judged repairable are traded to the stockroom on an even exchange for new or serviceable units,



The log sheet is made up from the pilot's flight report

Three tags for inspected parts. The 'serviceable' tag is yellow, the "repairable," green, and the "condemned" tag red. An identification tag, similar in size and form, is blue.

and are then tagged with a green slip, from 124, reading "repairable." The slip also gives the necessary data on the part and place from which taken. The unit is then repaired, under a separate job order, and all work and material is charged to that job order which, in turn, is charged against the engine or plane from which the unit was taken. It is then replaced in stock tagged with a yellow card, from 125, marked "serviceable."

Before a major overhaul is started the foreman examines the plane or engine and lists on a separate form all new materials that will be required. His record is turned in to the storekeeper, who checks to determine if all necessary parts and materials are in stock. If not, a purchase order is issued at once covering materials required.

After the plane or engine is torn down the mechanic takes a requisition slip, countersigned by the foreman, to the storekeeper for all materials needed. The storekeeper issues them, charging them on form 81, the stores charge sheet, to the job under way. Form 81 is turned over to the cost clerk, who enters its contents in a Kardex file giving a perpetual stock inventory. It then goes to its respective job envelope, each job having a separate envelope on file in which are placed all its records and orders.

Monthly summaries

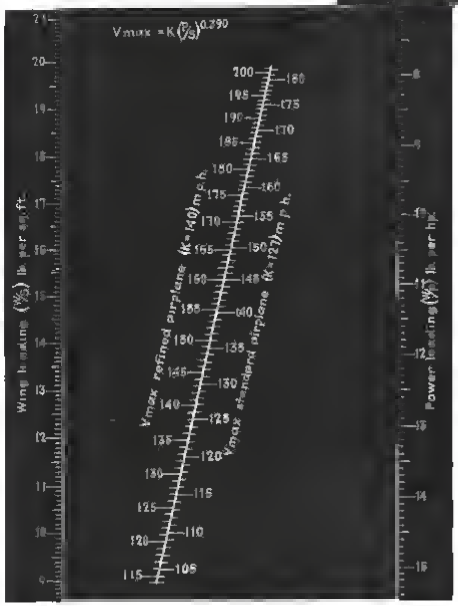
All the information outlined above is summarized at the close of each month, and complete reports are rendered both to the office of the comptroller and to the superintendent of operations. Constant comparison of the monthly reports enables the operations department to maintain a close check on all expenses, and economies are effected which well repay the cost incurred in gathering and compiling this information.

Nomographic charts for high speeds of single-engined planes (right) and for multi-engined planes, flying boats, and amphibions (below). For amphibions deduct 8 per cent

Two charts

Wing loading, power loading, and high speed

IN a recent article (AVIATION November, 1931, page 638) Mr A A Gassner in discussing the speed characteristics of transport airplanes gave several formulas for the calculation of maximum speeds of airplanes with given wing and power loading The formulas were based upon those originally set up by Edward P Warner,



modified to take into account airplane types of varying degrees of aerodynamic excellence The formulas are of the type

$$V_{max} = K \left(\frac{P}{S}\right)^{x}$$

where V is the speed in m.p.h.; P, the horsepower; and S, the wing area in square feet K, a constant and X, the exponents, vary with the type of airplane under consideration The charts give the limiting values

For convenience in using the formulas have been reduced to nomographic form By placing a straight edge to connect the power and wing loading factors on the two outside scales, the maximum speed can be read from the intersection of the straight line with the center scale. Values are given for standard airplanes, that is, machines of ordinary design where no unusual pains have been taken to obtain the least possible parasite drag and also for machines in which every possible means has been employed to render them aerodynamically clean With the two limiting values thus given the designer may readily compute the maximum speed of his airplane by interpolation In making use of these charts it must be remembered that the original formulas were derived from experimented data, and were intended for estimating only

Congress conducts its annual inquisition into the state of the national defense in the air

Naval aviation and the Air Corps "tell all"

EXAMINATION AND CROSS-EXAMINATION

ONCE upon a time, a British and an American naval officer discussed their respective professional problems "The thing that strikes me most forcibly about the American Navy," said the Englishman, "is that you have no facilities whatever for keeping a secret Once a year you have to go up and tell Congress everything that you have been doing and everything that you are planning to do. You have to reveal all your accomplishments of the past, and all your innermost thoughts of the future And then they publish it in a book for all the world to read"

It may not be quite as bad as that, but certainly there is nothing regularly prepared in any other country that parallels the annual hearings of the Congressional appropriation committees on the appropriation bills for the War and Navy Departments They lie before us on the desk. Twenty-one-hundred pages of examination and cross-examination and tabulation of every imaginable fact on the state of the Army and Navy—interspersed with occasional wit and humor, some of it entirely unintentional

The inquiry this year was perhaps even a little closer than usual, for the committees where determined to find opportunities for reducing appropriations. As usual, there were various questions upon the degree to which aviation was suffering at the hands of the older branches of the services As usual, it was difficult to get high ranking officers to commit themselves very categorically upon what the place of aviation is and what it should be, but upon certain points General Foulois, Chief of Air Corps, was extremely specific He was specific in his declaration that he had tried without avail to have the true place of the Air Corps in the scheme of national defense defined, that he did not definitely know what the policy in that respect was, and that as a matter of fact there appeared to be no policy. He considered it of the utmost importance, taking precedence over everything else, that one should be developed. He admitted, when forced to it by the chairman of the Committee, that it would appear to be the case that recent orders of the War Department, putting the Air Corps units under the commanders of the Corps areas, indicated the tendency to make the Air Corps merely an auxiliary of the ground forces; he was sure that the Chief of Staff was personally endeavoring to frame a more definite policy on the place of aviation, and that the officers of the Air Corps, including General Foulois himself, were "anxious to see military aviation expanded so as to take a more prominent place in connection with national defense and be used, as we know it must be used, as the nation's first line of defense"

Wanted—a revision in policy

The Chief of Air Corps indicated a conviction that too much stress had been laid on personnel in the planning of the national defense, and too little on material He thought the National Defense Act was about due to be rewritten from a new point of view, and for the Air Corps he specifically took as a basis "the policy that material should dominate the question of personnel"

In specific reference to the Air Corps, General Foulois felt that the Five-Year Program ought to be revised, as experience had shown it to be unbalanced On the exact nature of the unbalance he was not definite, but laid great stress on the necessity of an ample supply of transport and other "non-combat" planes if an efficient air force were to be maintained. The committee seemed to disagree with him on that point, for they harped endlessly on the need for a greater measure of concentration on "combat" planes, with less expenditure of money on observation, cargo, and utility types There was much talk of "sacred cows" a novel phrase apparently used by certain Congressmen to indicate airplanes reserved for the transportation of high officials

General Foulois believes "that we do not have an adequate air defense at the present time." He returned an unqualified negative, however, to the more extreme question: "Do you believe that we are in a state of totally inadequate preparedness?" At that point there began one of those confusing discussions, which annually blossoms forth in the appropriation hearings, on the relative strength of the United States and other powers The Chief of Air Corps "would say that we would be about fourth or fifth in proportion of numbers," but "when it comes down to using those planes . . . from what I have seen of the average American pilot, I would say that we could give them about half a plane and still be superior to them." It was a very high compliment to the American personnel When the same question was put to Secretary Davison he was more definite, and made no qualification He "could say categorically that if you combine the Army Air Corps and the Naval Air Service and compare their combined strength with the combined strength of the other powers in the world, we stand, as far as combat fighting strength is concerned, in fourth position." When the problem of relative strength was brought up in the course of the Navy hearings, the naval officers testifying elected to say it with figures They presented tabulations in some respects more complete than any that have been printed heretofore showing that the United States ranks first in total number of fighters, fourth in bombers, second in observation

planes, first in patrol machines, first in training types, and second in total number Numbers alone are deceptive, however, and nothing was said at that point of the relative age or merit of the machines, nor of the personnel and ground organization

U. S. planes challenge the world

The relative worth of American and foreign airplanes came in for the usual amount of inquiry from both committees. The witnesses were uniformly reassuring Even Secretary Davison, in spite of his pessimistic evaluation of our relative strength, "thought it was conceded that our tactical airplanes, generally speaking, were the equal of any tactical airplanes built anywhere . . .Generally speaking, our engineering capacity is in the front rank so far as production is concerned." General Foulois, backing his claims with a wealth of statistics and performance data, doubted "whether you will find, with the possible exception of the latest British pursuit plane, but what ours are equal to all other military planes, and at the present time we are way ahead of foreign bombing planes as regards speed." By way of further reassurance he gave the Committee the previously unpublished information that "we have pursuit planes coming out this spring which we hope will run about 250 m p h at high speed." That would of course be well in excess of the performance of any service pursuit ship that exists in any other country, so far as can be determined

Mr Collins of Mississippi, chairman of the sub-committee on the War Department Appropriation, is sceptical of official War Department pronouncements in general He seemed particularly sceptical on what was said on the merits of American airplanes, and quoting a miscellaneous collection of figures on Schneider Races, the three-flag flight of Mr Wedell, and the performances of the late Lowell Bayles, he deduced "that civilian planes are outstripping your Army planes" and that "these things would make it appear that about the slowest thing in the world in the aviation line is the Army plane." He was particularly enamored of the Rolls-Royce Schneider Race engine, and repeatedly endeavored to persuade the witnesses to commit themselves to the desirability of buying our power plants abroad rather than from the American industry—a suggestion which, for many obvious reasons, was received without enthusiasm by the service personnel

Mr Collins and some of his associates, showed the strong desire to penetrate to the heart of the technical aspects of the question which often characterizes the members of committees of inquiry They were somewhat handicapped, though not in the least hindered, by a scarcity of knowledge of the technical vocabulary and of the facts of the case, and the conversation sometimes became a little obscure as a result Thus, the following contribution to knowledge on the effect of "pants"

'Mr Collins I notice you have a plane that has the wheels protected with a sort of metal work.

'General Foulois. Yes sir

Mr Collins I have heard some complaint made about those particular types of planes, that they are very good planes but that protection has a tendency not to permit a man to land just exactly where he intends to land, provided there is a strong wind Have you gone into that?

'General Foulois Not particularly so sir The advantage we gain by using that protection over the wheel has been to increase our speed more than anything else, and the advantages gained in that way have offset any disadvantages that it might have for landing purposes'

Thus, again, and still more unfathomably, while the division of Army airplanes into first-class and second-class was under discussion

"Mr Collins Are the 'gas tanks" classed as grade A or grade B planes?

'Major MacDill. I do not know what you mean by 'gas tanks'

'Mr Collins. One of your men flew to Alaska in one of them

'Major Velandt. That was one of the P-Ts, I presume, with what we call the "belly" tanks, which are just used for cross-country purposes

'Major MacDill There was a special airplane prepared with capacity for a large quantity of additional gas for that flight.'

Thus, once more, a new idea on ordnance

Mr Collins Would a torpedo for land planes be more effective than a bomb?

'General Foulois I do not see where it would be

"Mr Collins. It might be in the Navy

"General Foulois Yes, they drop the torpedo into the water and it then proceeds on its way.'

The Navy witnesses agreed with General Foulois on the general superiority of American airplanes. They reported the existence of a Navy two-seater fighter making 195 m p h, well ahead of anything in Europe On observation types and on bombardment planes, Commander Mitscher reported our highest speeds just about equal to the best European figures On the big flying boats, we were again well out ahead of all competition High-speed single-seater fighters seemed to be the weakest point. Commander Mitscher, like General Foulois, was full of optimism about the future The Navy now has "one under development that will make 212 at 8,000 ft"

Super-speed airplanes

It may seem a little odd to rate the comparative merit of American and European airplanes solely in terms of their maximum speed, but the interest of Congressional committees habitually turns that way Mr Collins was particularly insistent on the importance of high speed, and seemed very regretful that he could not persuade General Foulois to agree with him that that quality overshadowed all others He repeatedly brought up the subject of racing, and suggested that our unhappy deficiency in super-speed airplanes was the consequence of our abstention from Pulitzer Races, Schneider Trophy Contests, and the like He had no luck in getting General Foulois to meet his views

The Navy committee was a little less interested in high speed, the Navy witnesses a good deal more so. Assistant Secretary Ingalls, in his introductory statement, laid extraordinary stress upon the current high-speed development and upon the necessity for a continued appropriation for carrying it on Commander Weyerbacher subsequently explained that the $220,000 already appropriated for that specific purpose had gone principally into power-plant work and into the development of miscellaneous accessories such as spark plugs and propellers. A like sum would be needed for further engine development during the coming year, but it was anticipated that enough money could be plucked from the regular experimental funds to build the high-speed airplane for which fundamental design data were being assembled under the special appropriations.

As was noted in the analysis of the Federal Budget published in AVIATION for January, neither the Army nor the Navy suffered much from high-pressure economy in their allotments for next year's experimental work The total allowance for experimental work in the estimates, in fact, was about $500,000 more than the appropriation for the present year The hearings gave an opportunity of explaining the breakdown of the estimates, and made it apparent that, however the aircraft industry may suffer on military production work, it is to get more experimental contracts than for some time past

In connection with the purchase of planes and engines in quantity, the hearings contained some echos of the criticisms that have been made of governmental purchasing methods, and of the alarm that has been expressed from time to time over the possible annihilation of the American aircraft industry by unwise and undue and arbitrary ecooomies. The representatives of the services expressed some sympathy with the industry's difficulties, but the committees either didn't get the point or didn't care, and some of them seemed to consider the position as that of a greedy group, demanding that they be fattened at the public trough for no public good

Admiral Moffett, in particular, did his best. He "desired to invite attention to the serious condition of the aeronautical industry of this country," and explained the serious effect of the sudden decline in commercial demand after the industry had seemed to be well started on the transition from a purely military footing to a largely commercial one. The Committee let that pass without comment at the time, but subsequently Mr. French, the ranking Republican member of the Naval Appropriation sub-committee and for many years its chairman in Republican Congresses, returned to the subject with an appearance of some indignation Thus

'Mr French When we get up to a certain number of manufacturing establishments it would seem that it would be unwise that companies be established if their permanence is based upon Army and Navy business. If they can not live without Army and Navy business, they should not be established. We do not want the Army and Navy aviation maintained for the benefit of private industries. We feel that it is a very fine thing for the Army and Navy that there should be keen competition in the industry and that companies are able to compete, but on the other hand, I am receiving letters pleading for greater liberality towards the Army and Navy in aviation Why? Is it because of national need? No But liberality just for the sake of the industry."

The Chairman of the Military Affairs Committee pursued a similar line of thought, questioning the Chief of Air Corps

"Mr. Collins. General, is this program made up for the purpose of providing the Air Corps with planes in which they can fight and with that end in mind, or is it made up for the purpose of providing the airplane industry with work? Is it made up for the purpose of giving us an adequate air force, or is it made up for the purpose of aiding the industry?

"General Foulois. It is made up entirely so far as the number is concerned, and so far as I have had any knowledge of it for the past year, for the purpose of creating an adequate air force for combat purposes in the interests of national defense. There has not been to my knowledge, any effort to build up that program in the interest of the industry."

Similarly, Mr French's interest in the state of the industry led to the inclusion of a surprisingly long list of aircraft manufacturers that now hold Navy contracts Planes are actually being built for the Navy at the present time in seventeen factories, including fourteen completely independent industrial units.

Airplane shortages

The general materiel situation shows the Navy in good shape for the present, but facing new demands in the future, while the Army's equipment lies persistently below the standard established by the Air Corps act of 1926 The present outlook is that at the end of the next fiscal year, which will be seven years after the Five-Year Program was enacted, the Air Corps will still be 185 planes short of the 1,800 for which the act called The Navy, having got off to a start a year ahead of the Army, has completed its Five-Year Program, but has no provision as yet for planes for the new aircraft carrier now under construction Furthermore, in order to equip the recently-finished cruisers with observation planes it has been necessary to strip Hawaii and Panama of patrol and bombing equipment, reducing the complement of those stations from the 226 planes originally planned to a total of 96

For the first time in a number of years the Air Corps gave no detailed analysis of its present equipment in the course of the hearings The Navy made up for the omission by going into more detail than ever before As of Nov 1 it showed 216 fighting planes on hand (including the obsolete types) The Boeing F4B, essentially the same as the Army's P-12, plays the predominant part with 64 now in service and 75 more on order for early delivery Observation planes were 343, 303 of them Vought Corsairs, and 121 more Corsairs were under construction at the time of the hearing—many of them having been delivered by now Of bombers the Navy totals 117, all except thirteen being of the T4M type and of a very similar model built by the Great Lakes Company in the old Martin factory Twenty-eight new Martin diving bombers are under construction Patrol planes total 109, 100 of them biplanes and nine monoplanes Twenty-three more monoplanes, however, are now being built by Consolidated Trainers, 183 in number, are all from the Consolidated plant except nineteen. No new trainers are under order now, and only 25 were planned for order during the next fiscal year. The allowance for new aircraft having been cut by about 15 per cent by Congress, however, that purchase may have to suffer with the others.

Miscellaneous information that the hearings provide on materiel questions The Army has 161 Liberty-engined planes on hand—6,289 Liberty engines are in storage, of which 5,413 are shortly to be sold to the public on sealed proposals—the Army overhauls its engines every 250 hours on the average—General Foulois said that 'the aircooled engine continues to dominate the field"—the Navy has been making rapid progress towards the development of satisfactory radio sets for single-seater fighters—the allowance for work at the Naval Aircraft Factory is being cut about one third from the present year's figures—high-grade gasoline, including full ethyl treatment, now costs the Army about 13¾ cents a gallon, the Navy about 10½; the Navy gets it cheaper because of taking it all at tidewater—oil costs the Navy 38 6 cents per gallon last year, is estimated at 21 3 cents next year—the Army has been working on improved electric bomb controls; designing cockpits for improved crash strength to protect personnel; many devices for fog flying, but hampered there by lack of funds; chrome-nickel control cables to eliminate corrosion; magnesium alloy gun mounts and seats—corrosion and other troubles due to the use of tetra-ethyl lead have been overcome by stainless steel exhaust-stacks—the Navy's required rate of replacement of airplanes, originally estimated as one-third each year, has actually averaged exactly one-quarter over the last five years—airplane costs, which have been going down steadily for five years, are now showing a tendency to rise because of the demand for higher-powered engines and more elaborate types of construction—after long pursuing the policy of buying one complete spare engine for each new single-engined airplane, the Navy has reduced the ratio of spare engines to one-half per plane

Gar Wood's engine for aircraft

HARRY A. MILLER, well known builder of engines for racing cars and motor boats, has designed a 2,000-hp aviation engine He has announced that he is prepared to contract for one or more engines, guaranteeing reasonable limits of power, weight and performance. The proposed engine is an adaptation of the sixteen-cylinder marine engine recently developed for Gar Wood, two of which have been delivered for use in his next high speed boat.

As a powerplant for aviation use the engine is expected to develop 2 000 hp at 5,500 r p m with a weight of from 1,000 to 1,250 lb It is geared 2·1 and is supercharged by a centrifugal blower The sixteen inverted cylinders are arranged in two banks of eight, 45 deg apart. Cylinder bore is 4½ in, and stroke is 4½ in. Cooling is by prestone liquid The maximum frontal area of the fully cowled engine is 518 sq in., or 3 6 sq ft, when a downdraft carburetor is used The overall length is 90 in., maximum width is 25 in, and maximum height is 32 in

The side of the loft floor with a continuous straight edge fastened to it is shown at the left of the picture. The other half of a body plan is shown scribed to the floor and about it have been grouped a number of the tools used in lofting as well as several bulkhead forms which have been made from the loft. The flat plate with the handle is placed between a form and the loft floor while nailing the former and serves to clinch the nails. The adjustable triangle shown in the foreground is used for determining bevel angles. The other objects are described in the text.

The mold loft

Its economical application to aircraft construction

By Arthur E. Raymond

Assistant Chief Engineer, Douglas Aircraft Company

THE manufacture of any object having contours made up largely of curved lines, such as a boat, an automobile body, or the monocoque fuselage of an airplane, requires first the determination of an accurately faired set of contour lines. That is, if the object be assumed cut by families of horizontal, vertical, and transverse planes, the intersections of these planes with the body must be smooth and consistent with each other. For comparatively small objects such as an airplane propeller, the lines may be developed on paper, but for large ones this has its disadvantages. Paper shrinks and swells due to changes of weather. Drawings of large objects made upon a drafting board must be drawn to a reduced scale and therefore cannot be used directly in the manufacture of templets and forms.

Due to these limitations, shipbuilders for many years have made use of a specially prepared wooden floor, which they term a mold loft, for laying off lines at full scale. This method of fairing was carried into aircraft construction by the first builders of seaplane floats and flying boat hulls, and until recently it seems to have been confined to seaplane work. It is now finding extended usage in developing lines for all portions of the airplane requiring faired contours, and these are steadily becoming more numerous due to the advances being made toward better streamlining. The industry's best efforts are being exerted to obtain more speed with the same power and to increase visual attractiveness as well. Indeed, one basic reason for the trend toward monocoque construction is its adaptability to streamline shapes. This brief description of construction and methods of use is given for the benefit of those in the industry who have not yet found occasion to employ it.

A portion of a typical mold loft is shown above, together with a number of the tools used in laying off lines. The loft floor is made of straight and vertical grain spruce flooring, tongue and grooved, laid over a substantial base. It must be carefully and rigidly constructed in order to avoid shrinkage or warpage due to changing moisture content which would distort the lines upon it. A good size for aircraft use is 20x60 ft and if likely to be moved at any time during its useful life, it should be made in three sections and bolted together. A heavy sub-floor should first be laid, the planks running on the diagonal, on a frame at least 6 in. thick. The frame may be placed directly on the floor of the building. Frame and sub-floor should be given two coats of paint to avoid absorption of moisture, this to be done before the main floor is laid.

The working floor should be made of 1-in. planks preferably about 4 in. wide. It is desirable that they be as wide as possible without warping in order to reduce the number of cracks between planks. The floor should be laid on the diagonal, at 90 deg. to the sub-floor. This will avoid confusion between the cracks and vertical station lines which may later be laid off. After laying, any imperfections should be filled with plastic wood and the floor thoroughly sanded by machine.

The finish must be durable, with a surface slightly gritty in order to give it enough tooth to take the lines well. This can best be obtained by painting with at least three coats of carbon black lead paint to which a little pumice has been added.

Loft teminology

The terminology of lofting is picturesque and, having been developed through years of ship practice, will probably undergo little change when applied to aircraft work, especially where the loft is presided over by an experienced ship loftsman. For instance, side plan, and cross-sectional views when applied to the loft are known as sheer, halfbreadth, and body plan. The body plan, showing cross-sectional lines at

stations, usually equally spaced, over the entire length, is the key to any three dimensional body and, if this is preserved and the interval between stations known, the other two views can be laid off from it at any time. Consequently, although all the original fairing is done with lines made with soapstone, as soon as these have been determined to the point where further changes are unlikely, the lines of the body plan are scribed that is, cut into the surface, with a specially shaped knife which cuts a small V-shaped groove. The lines may then be picked up later even though several subsequent sets may have been laid off and the loft may be used several times before re-surfacing.

Apparatus

The loftsman must have at his disposal means for accurately constructing parallel, perpendicular and curved lines, as well as lines at any prescribed angle to one another. A straight edge should first of all be screwed solidly along one edge of the floor. This is used as a base line for all subsequent operations. Scales and tapes are next in order. A large wooden square may be slid along the base line for erecting perpendiculars but these should always be checked, if they are of primary importance, by trammelling. If the loft is first covered with a grid of lines spaced horizontally and vertically at 5-ft. intervals, accurate laying off of points to set dimensions will be facilitated.

Compasses and protractor of large size are, of course, necessary. Probably the most useful of all, however, are the tools for constructing curved lines, namely the battens and "banjo." Battens should range in size from 1x1x30 ft to ¼x1¼x4 ft. The large stiff ones should be constructed of straight grain spruce or white pine and the small limber ones of pyralin or hard rubber. Two means are used for holding battens in place while fairing and laying off a curve. The small ones are held by cast lead "ducks," larger, but of the same type as those used in the drafting room. The large ones are pegged by means of tenpenny common nails driven lightly into the floor on alternate sides of the batten at intervals which vary according to the sharpness of the curvature but which should be as great as possible in order that the batten may not be restrained from taking a smooth curve. An ordinary claw hammer is used.

The "banjo" previously referred to is a device used for transferring a curve from one location to another. One kind consists of a batten attached at intervals to a stiff straight edge by adjustable sliders with thumb nuts (see Fig. 1). Another type of banjo, shown in Fig. 1, is made by attaching a number of short sticks to a batten at intervals. The batten is bent to follow a curved line on the loft such as the outline of a bulkhead and held in place by nailing the other ends of the sticks to the floor while the line is transferred to a board slipped under the batten.

"Take off" sticks are used in transferring points from one view to another, and sometimes for preserving offsets when it is not desirable to scribe the body plan. These are short battens about one inch square. The four surfaces are used in continuous rotation to mark off the height from the base line to significant points on the body plan. One stick is used for each cross-section and the marks on it are accompanied by a notation describing them in a definite way. For instance, if a hull is the body being lofted, each take-off stick will be numbered to correspond to the bulkhead or section to which it applies and successive marks on it will be designated "keel," "keelson No. 1," keelson No. 2," "chine," "longitudinal No. 1," etc., denoting the intersection of these numbers with the section in question. A set of sticks will then contain sufficient information for laying off the body plan at any later date without it being necessary to determine each point by scaling and reference to a table of offsets.

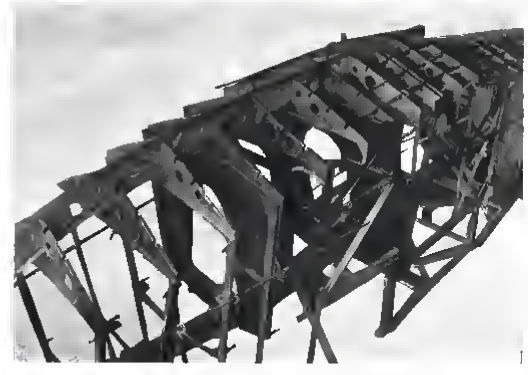
Fairing, that is obtaining consistent smooth contour lines in three views, is of course the loftsman's main work and in time he becomes exceedingly adept at it. Although it is, except in special instances, a trial and error proposition, practice will enable him to cut down to a minimum the number of trials and to reduce the error as a rapidly converging series. In this fairing process use is made not only of the intersections with the body of families of horizontal and vertical planes, but also of diagonal ones. These are chosen so that they will intersect the body at angles close to 90 deg. These diagonal planes, instead of being projected perpendicular to themselves in the manner of projections on drawings are projected by rotation into either the half-breadth or the sheer, a process called "rebatting." This is necessary in order to conserve space.

Another dodge useful in fairing long shapes with lines having slight curvature is that of reducing the horizontal scale of sheer and half-breadth. This has the effect of increasing the curvature of the lines and making irregularities more apparent to the eye. It is called fairing by contraction.

Lofting procedure

The procedure in lofting aircraft work is as follows, with variations of course depending on particular conditions. The lines are first drawn on paper in the engineering department. This first set of lines need not be drawn with extreme accuracy nor be carefully faired, but it should indicate the desired shape and necessary clearances. Working from these, the loftsman will develop three consistent and accurately faired views and from the resulting body plan determine the table of offsets and forward it to the engineering department for its information. These offsets are the intersection points of lines of reference with the surface of the body, taken at sections, preferably equidistant, along its length and sufficiently close together accurately to define the shape. The sections are numbered to correspond to their distance from the forward end of the body. Thus "Station 232½" is that many inches back from the nose or bow. The engineering department enters this tabulation of offsets upon its lines drawing which can when convenient be redrawn to scale if any noticeable discrepancies exist between it and the lofted lines.

Let us assume for sake of illustration that a monocoque fuselage is the item which has been lofted. From this point on, any dimensions which can be deter-



A lofted hull in process of construction

mined from the loft need not and should not be shown on drawings, for this would entail unnecessary duplication of effort. Bulkhead drawings, for instance, should be drawn to scale as to outline from the offsets but no dimensions referring to this outline should be given. The only information required on the drawing is the size and gauge of members and the number, size and position of rivets. If the monocoque is the smooth skin type utilizing stiffeners or longitudinals, the position of these where they pass through the bulkhead should not be dimensioned; instead, the lines of the longitudinals should be laid off on the loft and reference made to it for their position. Their size will be called for on the frame drawing of the fuselage along with the part numbers of the bulkheads.

Simplified riveting

With the aid of the loft, the amount of riveting information on drawings is considerably lessened. Riveting standards are first drawn up by the engineering department covering general rules requisite for strength. These standards will list for each size rivet the pitch or center distance between rivets, number of rows, distance between rows, and the minimum distance between rivet and edge of plate termed "landing." They will also indicate what size rivet is to be used for each gauge of plate. They will state what is standard practice in riveting watertight and non-watertight joints.

By reference to these standards the loftsman can show on his templets rivet position and size for all seams without further information. Rivets attaching members (other than plating) to each other or to gussets should be called for on the drawings by size and number required and their general position or rivet pattern indicated to scale but without dimensions. The loftsman can then lay them off on his templets in accordance with standard practice with reference to pitch and edge distance. Fig 2 has been prepared to show the difference in amount of labor involved in drawing a bulkhead with and without the aid of a loft.

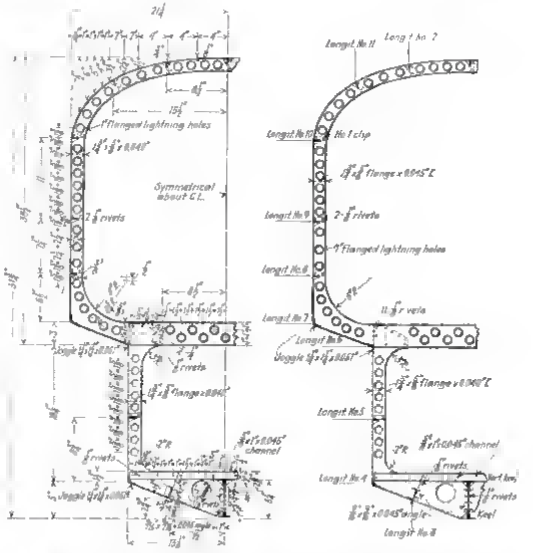


Fig 2: Comparison of bulkhead drawings made with and without the aid of a loft. The drawing on the left is completely dimensioned in itself, the one on the right gives only such information as required by the shop additional to that contained on the loft templets.

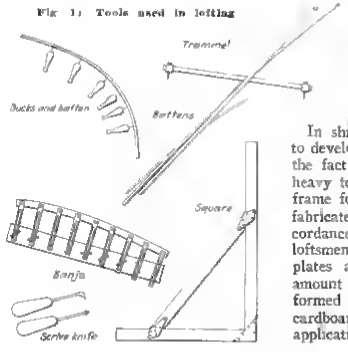


Fig 1: Tools used in lofting.

The drawings which will be required for the construction of a hull or monocoque fuselage comprise bulkhead drawings, frame assembly and shell expansion. The frame assembly calls for all bulkheads by number as well as all longitudinals, keel, chine, etc., and the shell expansion drawing calls for all plating. One view suffices for this purpose, the sheets being indicated as though unrolled and flattened. The shell expansion drawing need only be a pictorial representation since dimensions, taken from the loft, are of no consequence on the drawing.

In shipyard practice it is customary to develop all plating on the loft due to the fact that individual pieces are too heavy to be placed against the ship's frame for fitting. The plates are then fabricated, formed, and punched in accordance with templets supplied by the loftsmen. In aircraft work unbumped plates and those with only a slight amount of bumping can usually be formed and trimmed with the aid of cardboard templets and successive trial applications against the frame. Heavily bumped plates or those having an irregular contour can best be fabricated to fit a wooden form built directly from the loft.

Templets and forms

After the lines are once laid off, the loftsman's activities center about the manufacture of templets and forms. Gusset templets, bending blocks for curved stringers, bulkhead jigs, and all manner of bumping forms, are constructed directly from the lines on the floor. These forms are roughly made but are accurate as to outline. They have written upon them practically all information necessary in constructing the bulkheads, such as size of members, etc., and the assembly work is done directly upon them. After bulkheads or frames are made they are set up at the proper intervals in a jig and are held accurately in place, before the longitudinals are attached, by means of marked battens made at the loft and clipped to the bulkheads with C-clamps. A number of these are shown in the illustration on page 265.

From the foregoing, it may be readily seen that the mold loft is a valuable adjunct both to the engineering department and the shop. Lofting has proved itself, wherever used, to be both a time-saver and a money-saver. As such, it finds many applications.

The S.A.E., at its Detroit meeting, discusses the problem of keeping equipment in service

Maintenance from two points of view

THE OPERATOR AND THE MANUFACTURER

THE Society of Automotive Engineers has included many papers on the maintenance of aircraft in service in past aeronautical programs, but practically without exception they have come from the personnel of operating companies. The only recent departure from that general rule was made at the meeting during the Detroit Show, where John G. Lee of the American Airplane and Engine Corporation, builders of the Pilgrim, spoke on "Airplane Maintenance as the Designer Sees It." The Detroit maintenance session was further distinguished by the first discussion of the problems of keeping equipment in service as they appear to the transport operators as a whole. Luther Harris, who wrote a paper on "Air Transport Maintenance Problems from the Service View Point," was acting as chairman of the maintenance committee of the air transport section of the Chamber of Commerce. In large measure he expressed the collective views of all the operators taking part in the work of the Chamber, not merely those of the Ludington Air Lines, with which Mr. Harris has had his own recent experience as superintendent of maintenance.

Table 1: Analyses of direct operating costs for single-engined and tri-motor airplanes. Cost in per cent of total direct operating cost without pilot salary (Also excluding overhead, office expenditures, traffic solicitation, etc.).

	Large single-engined passenger planes	Three-engined, all-metal planes
Airplane maintenance and overhaul	25.9	20.6
Engine maintenance and overhaul	15.3	19.4
Fuel and oil	17.8	19.1
Insurance	8.4	7.0
Airplane depreciation	19.8	20.6
Engine depreciation	12.8	12.5
Total	100.0	100.0

The total of the direct operating cost per mile (without pilot salary, as noted above) for the tri-motor was 80 per cent more than for the single-engined type.

Table 2: Apportionment (in per cent) of airplane maintenance costs

Wing	16.0
Fuselage	20.3
Cabin	15.2
Control system	8.2
Landing gear	13.2
Instruments	5.0
Fuel system	7.0
Oil system	1.2
Engine controls	2.6
Cleaning	1.9
Miscellaneous	9.4
Total	100.0

The meeting was further marked by the chairmanship of R. C. Marshall, president of Transamerican Airlines. At no previous technical session of this sort has a chief executive of a leading transport line taken personal charge of the proceedings.

Mr. Harris' paper covered such a tremendous range that it was necessarily little more than an abstract itself. Each recommendation for future design practice was summarized in a sentence. Among the most striking points in the paper was the warm insistence on simple cabin interiors, easy to clean in case of airsickness. Fabric interiors and rugs were rejected as staining too easily. Linoleum-covered plywood was approved as a floor covering, but better means of waterproofing the plywood are needed. Bakelite interior trim for the cabin was suggested as approaching the ideal. Incidentally, it was interesting in that connection to note that the bakelite exhibit at the show made a feature of micarta sheet in a variety of colors, with elaborate decorative patterns molded directly into the material.

Mr. Harris objected to trick ventilators and heat controls individually manipulated by the passengers, and spoke favorably of ventilation controlled by the pilot. In any case, he felt that the pilot must have a distance-reading thermometer to give him the cabin temperature.

Fabric, plywood, or dural?

Discussing airplane structure, he indicated that maintenance costs had been found higher with plywood-covered wings than with fabric or dural covering. He seemed favorably inclined toward the dural, but remarked on the increased flexibility that fabric permits. Duralumin covering was definitely approved for the fuselage, where it is less likely to cracking and rivet breakage than on the wings.

If the choice were left to the maintenance force, said Mr. Harris, high-pressure tires would still be in vogue. He admitted, however, that the low-pressure type were being greatly improved in accessibility and reliability. He thought that landing gears in general suffered from inadequate bearing surfaces and from the failure to use removable bushings in some cases where they would be desirable. Larger brake-drum areas were advised, as the slightest deterioration in brakes now provided makes them inadequate for their work.

Control bearings

On controls, as on landing gears, larger bearing surfaces and more anti-friction bearings and removable bushings have been found a major need. Ball-bearing pulleys were particularly recommended. Nothing was said of ball-bearing hinges, but control hinges in general were criticized for inadequate bearing area and unduly rapid wear. Push-and-pull controls, Mr. Harris declared from the operators' experience, should run through guides which are softer than the control rods themselves, in order that the wear might be on the guides and that the cheaper member may be replaced most frequently. Mr. Lee, author of the other paper, dissented on that point, suggesting that wear at such points is almost always the result of cutting by grit caught between the two surfaces or embedded in one of them, and that abrasive particles are much more likely to be embedded in a soft material as a matrix than in a hard alloy. No matter how soft the guides are in other

words, the hard rods may still suffer from scratching

Engine installation troubles

As usual in maintenance papers, "plumbing," and especially fuel systems came in for a deal of attention. Tanks should have manholes for giving access to the interior. Fuel strainers should be much more accessible than they commonly are. Fuel tanks of oval shape were strongly recommended for easy maintenance, flat surfaces being a source of constant trouble.

The engine installation was severely criticized as lacking in intelligent engineering or even in simple layout. Mr. Harris concluded that in many cases the location of the engine had been fixed on the drawings and that it had then been left for the mechanic doing the installation to run pipes and wires through wherever he could find a hole. Present-day electrical equipment was reported in many cases to be inadequate to carry the loads imposed on it. Some large planes have a constant drain on the storage battery of 60 amp. for night flying, rising to over 100 amp. while landing. Batteries have to be changed after every three or four night landings in such cases. Unless there be a general revision of electrical systems to increase their capacity or to provide for continuous charging at a higher rate while in flight, Mr. Harris warned that electrical maintenance costs would become prohibitive. He exempted the battery manufacturers from one demand, however, when he said that there was no occasion for non-spill batteries on transport planes. They are needed only where acrobatics are to be performed.

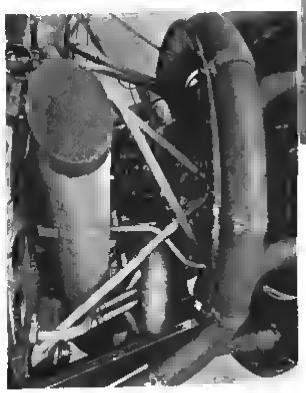
Radio troubles are generally of the nature of ignition-system difficulties caused by the radio, rather than failures in the communication equipment itself. Shielding is still a problem, calling for further research and for cooperative study by manufacturers and operators.

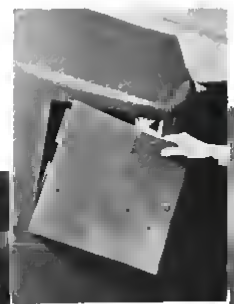
The discussion of Mr. Harris' paper was brief, as the author had been unable to attend the meeting himself and his contribution had to be read by William E. Berchtold of the Aeronautical Chamber of Commerce. Richard M. Mock, formerly technical editor of AVIATION and now working with Mr. Fokker, pointed out that some European governments, particularly that of Germany, require the reduction of bearing loads by two-thirds wherever there is relative movement between the surfaces in contact, so reducing the rate of wear, but that the United States has no such official stipulation. A question on the relative cost of airplane and engine maintenance brought forth no very definite conclusions except that experience differs. Mr. Marshall, of Transamerican, thought that the two factors should be about equal on single-engined planes as a general rule, while engine maintenance costs would run twice as high as those on the airplane structure on three-engined planes. Mr. Lee gave in his paper some figures for particular airplanes which showed the two quantities almost equal on a tri-motor, with airplane maintenance exceeding engine maintenance by 70 per cent on a single-engined ship. [Mr. Harris himself, in an earlier paper abstracted in AVIATION for December, 1931, had indicated that on the Ludington Line tri-motors the cost of airplane maintenance was about two thirds higher than that of engine maintenance, a ratio almost exactly opposite to that which Mr. Marshall's experience suggested.]

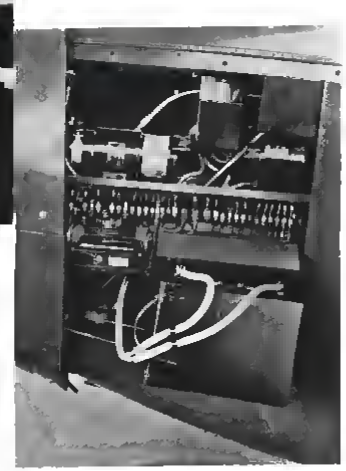
As the designer sees it

Mr. Lee's paper, from the designer's point of view, was less concerned with particular devices for improving maintenance qualities than with an appeal to the operators to give the designer some clue to what they really wanted. Mr. Lee suggested that the manufacturers fully realized the importance of maintenance, but that it was often necessary to make sacrifice of other qualities in order to secure the highest degree of maintenance economy, and that such sacrifices could hardly be ventured unless the operators gave some evidence that they, too, put a high rating on the maintenance factor. He dismissed as of little or no value such general observations in the specifications for new equipment as "All parts of the airplane should be easily accessible, and the design should be such as to reduce replacement and necessary attention to a minimum." He called for definite specifications, in terms of number of men and number of minutes to perform certain specified operations.

Mr. Lee remarked particularly on the surprisingly large share of maintenance cost that has to be allotted to fuselages and wings. He thought the importance of those factors prone to be overlooked, since every time that one went near an airplane in a hangar a mechanic would appear to be tinkering on the instruments or controls, and the wing apparently never received or demanded any attention at all. The explanation was, of course, that the wing and fuselage maintenance cost landed on the operator in one solid chunk at the time of general overhaul. The work was all done in a few days, and didn't force itself on the attention as did the less intensive and less expensive operations of daily service routine.







Above: A readily removable inspection door, held in place by a single cowl fastener. Left: The fully-detachable power plant of the Pilgrim monoplane. Note the mounting for rubber cones, one of which is shown in the upper left hand corner, stopping vibration and taking care of all errors in alignment. Right: Grouping all electrical equipment behind a single section of the cowling for quick accessibility.

A maintenance yardstick

In calling for definite maintenance specifications, the author exactly followed the course taken by Ralph G. Lockwood, chief engineer of Eastern Air Transport, in his articles in AVIATION for January and February, 1932. Since Mr. Lee's figures for some thirty operations were prepared quite independently of Mr. Lockwood's, comparison was of immense interest.

Unfortunately, there is only a very limited overlap between the two tables, each author having specified for a number of operations that the other ignored. On some fifteen items, however, direct comparison was possible. In spite of the fact that there was some criticism of Mr. Lockwood's specifications, when they first appeared, as impossibly severe, Mr. Lee's statement of the conditions that the manufacturers ought to be willing to meet was even more severe in three cases out of four. In some cases the difference was enormous, but as a general rule Mr. Lee allowed about one-third less time than Mr. Lockwood proposed for the same number of men. Of particular interest in Mr. Lee's specifications, presumably based largely upon experience in developing the Pilgrim monoplane, were the requirements that three men should be able to change the entire power plant in 30 minutes, and that one man should be able to remove all the cowling, including the ring, in four minutes, and change the storage battery in the same length of time.

Passing to more general matters, Mr. Lee classed all troubles under the general headings of wear, deterioration, and fatigue. To reduce the wear he recommended ball-bearings, with oilless bushings in many cases where ball-bearings could not be used. Much wear is due to hammering where the clearances between moving parts are unduly large, and the author suggested the use of clevis bolts made to very close tolerances.

"Save the surface"

Deterioration was assigned largely to improper finishing, but the cost of good finishes was emphasized. Few people realize that, as Mr. Lee gave the figures, the dope alone on a ten-passenger plane with highly-polished finish on wing and fuselage fabric weighs as much as 90 lb., almost 5 per cent of the payload. Cadmium plating was to be used with caution, as becoming a positive menace whenever porous welds or cracks in the material permitted the penetration of electrolyte from the plating solution. The author believed it economical to spend more money and to use non-corrosive materials, such as bronze or stainless steel, whenever possible.

Fatigue was at its worst in fuel and oil lines, in control cables, and in instruments and their connections. Mountings offering proper flexibility were of fundamental importance in the first and third cases, but excessive flexibility was dangerous, since it permitted free vibration. The mounting should not merely be springy, but should also dampen any vigorous motion. Mr. Lee considered felt preferable to rubber as an instrument board backing, and spoke highly of the use of flexible tubing for fuel lines. Streamline wires could best be protected by the use of truly universal terminals, in place of the standard type permitting motion only around a single axis.

Small fittings make a great deal of trouble, and the author spoke with particular feeling of the lack of any satisfactory lock for cabin doors. He found them all too heavy or too unreliable.

He warmly favored detachable engine mounts, but considered that most of the mounts alleged to be detachable were snares and delusions, and required the breaking of a great number of individual and troublesome connections before the engine could be removed. The truly detachable mount has the special advantage of making it easier to get at accessories, since engine designers insist, to Mr. Lee's great disgust, on mounting them all at the rear.

It was suggested that a detachable engine mount be supplemented by a detachable tail section in the fuselage, with the stabilizer and fin mounted just forward of a bulkhead in the fuselage and the tail wheel carried just aft of the bulkhead. The removal of the fairing that carries the fuselage out to a point would then expose the tail wheel and various essential control elements. Considerable scepticism was expressed on the maintenance qualities of existing retractible landing gears, and the difficulty of building wheel streamlines, or "pants," which would not vibrate or clog up with dirt was emphasized.

Inaccessible instruments

Another troublesome point upon which Mr. Lee dwelt at length, was the mounting of the instrument board. The pilot wants the board as far forward as possible, with the result that there is almost no clearance behind it in which a mechanic can work. Some instruments can be mounted on the front of the board and withdrawn completely from the front, but on tachometers and air speed meters the connections are likely to prevent anything of the sort, and a mechanic must work in a space of an inch or two in breaking the connections.

The principal contribution to the discussion was made by the editor of AVIATION, who remarked upon the parallelism between Mr. Lee's specifications and those recently published by Mr. Lockwood but also upon the fact that only in a few cases had they chosen identical operations for specification. He suggested that it was desirable for the air transport section of the Chamber of Commerce to attempt to standardize a list of operations which would be used in rating on maintenance quality, and even to get up a score-card on which a series of operations would be rated so that a single figure could be given to represent the average maintenance quality of an airplane in a general way. Mr. Warner also called attention to the great importance of maintenance and other costs as compared with depreciation, and suggested that the figures given in Mr. Lee's paper were a potent argument for scrapping some of the air transport airplanes now in use without waiting for them to wear out completely, deliberately abandoning them while they are still useable in order that they may be replaced with more modern equipment which can be more cheaply maintained. He further raised the question of the relative maintenance qualities of military and commercial airplanes, the Army having taken the specification of the time required for maintenance operations very seriously long before it became the subject of attention by commercial operators.

S. Paul Johnston, also of the staff of AVIATION, spoke from experience gained during a recent tour of almost all the large maintenance bases in the country. Mr. Johnston believed that there was particular need for a more extensive discussion of maintenance matters and exchange of information on maintenance methods through the press, and also stressed the importance of closer communion between the manufacturers and the operators of equipment. He took Mr. Lee's paper as a very hopeful sign, and as an admirable description of the ways in which a transport airplane ought to be developed.

Replying, the author of the paper expressed regret that the commercial operators were not more particular than was actually the case. He found the Army much more insistent upon attention to detail than the transport companies, and the reason was that the transport operators purchased at the last minute and then were in too much of a hurry to get their new ships to wait for the amount of fussing with detail that would really be desirable. However, at the present time he thought that the maintenance qualities of transport planes were at least as good as those of military craft. Mr. Berchtold of the Chamber of Commerce agreed with Mr. Warner's suggestion that a general maintenance score-card would be desirable. The maintenance committee of the air transport section of the Chamber, he said, had already drawn up a preliminary draft of a code of suggestions for manufacturers of equipment.

EDITORIALS

AVIATION

EDWARD P. WARNER, *Editor*

Time to buy airplanes!

AMERICAN air transport operators are on the point of having to take a great decision. Some time very soon, they will have to put it on the record whether or not they really believe that any progress has been made in airplane design in the last few years.

At the beginning of this year there were almost 600 planes in transport service in the United States. More than two-thirds of them will be three years old at the end of the coming summer. Practically all of the machines built in 1929 or earlier could be kept going for two or three years more without great difficulty. It is up to their owners to decide whether the useful life of flying equipment ought to be stretched to the limit, or whether it is profitable to let old planes pass to the scrap-heap to be replaced by new. There has been a good deal of talk of economic obsolescence and its importance as a factor in air transport operations. It has so far been an abstract quantity, about which we talked and theorized. Now the question is in our midst, and demands that we decide upon a course of action without further delay.

We are in an *impasse*. Manufacturers protest that they can hardly be expected to assume the great expense of developing new transport models, or thoroughly modernizing old ones, while operators are frankly proclaiming that their present equipment will be good for a long time to come. At the same time the operators complain that, whatever their inclinations might be, they are unable to make purchases, since only a few of the manufacturers, covering only a few classes of equipment, have undertaken to produce designs meeting 1932 ideals.

It is a real dilemma. To find a way out will require concessions all around, but especially it will require the display by the transport lines of a considerable measure of willingness to get out and spend money. In some cases it may be that a shortage of cash and the closeness of current banking policy will prevent the making of new purchases, however advantageous they might be, but there are plenty of other instances in which ample resources are on hand to cover any reasonable purchase. There are lines that are losing money at present that could immensely improve their current income position, if indeed they could not actually change red ink immediately into black, by modernizing their equipment. If they will show some sign of willingness to buy, and issue some definite specification for what they want, they will find manufacturers eager to meet almost any demand, even though no airplanes that exactly fit their needs may be in stock upon the shelves at the present time. As a general rule the seller approaches the buyer when a business transaction is to be attempted, but this is a case in which the potential buyer must take the initiative. If a group of operators can meet and issue a joint specification, so much the better for all of them.

The question of modernization goes deep. It is not limited to the purchase of new airplanes. It applies also to power plants, and to fuel, and to a variety of operating practices. There are engines still running in transport service that were designed to operate with the relatively low-grade fuels that were considered as an ideal three or four years ago. Real economy demands that money be spent wherever necessary in adapting such equipment to modern conditions.

It is altogether too easy to worship at the shrine of the great god depreciation. Where fuel costs and maintenance costs can be reduced, or a service made more attractive to the passengers, by calling for a fresh deal on equipment the prospect of a temporary increase in depreciation allotment ought not to act as a bar to the change. We venture to lay it down as a general principle that every airplane built in 1929 or earlier (380 of them) ought to be retired from transport work and replaced within the next eighteen months, and that the change would be a directly profitable one. There is no present indication that it will be done, but if the transport lines will make it plain that they intend to engage in replacement buying on a substantial scale in the near future it will operate to bring out some of the manufacturers who have been hibernating and greatly to increase the range and variety of strictly modern products from which a choice can be made.

Stop living in the future!

WE in the aviation business are a peculiar people. Ours is probably the only industry in the world which habitually seeks adverse criticism for its own services by setting up an unattainable standard with which to compare them. We go out of our way to persuade the public of the inferiority of what we have to offer, and then we express wonder that some of them are still backward about rallying to the standard of air travel.

If the members of the aircraft industry would retain a good psychologist to advise them on public relations he would tell them, among other things, that human beings form their judgment in terms of an imagined ideal,—that they are extremely impatient of any delay in reaching that ideal, or of any excuses for not reaching it,—and that (very fortunately) most of them haven't enough imagination or knowledge to create a very clear picture of their ideal for themselves. Somebody else has to do it for them. In most industries the policy has been to do everything possible to prevent the buying public from getting hold of the material to formulate any ideal that is out of line with present reality. In the aircraft industry, taking us as a whole, we have followed the reverse course. We have gone out of our way to provide a picture of a hypothetical scheme of air transport, compared with which present activities seem like the first uncertain steps of an infant in the nursery.

Just what does all this jargon of ideals and their formation mean, in practical terms? It means that we have been so spell-bound by the marvels of our own activities and their prospective future development that we have felt it necessary to let the general public in on the secret, so that they might marvel too. At the present time, the average commercial airline operates at somewhere around 120 miles an hour. We ought to be telling our customers what a wonderful achievement that is. We ought to be comparing the speed of air transport with the speed of the fastest previously existing facility. We ought to be filling them with gratitude that they have the opportunity of traveling at such an incredible rate. Instead of which many of us are prone, when we find ourselves facing an audience, to throw present performances lightly aside and to assure our listeners that within a short time speed of 200 m.p.h. will be common-place. They go their several ways, compare what they have just heard with the schedules of the air transport lines now available, and make up their minds that the present organizations must be notoriously inefficient to use such hopelessly slow machines.

One reason for the almost inevitable coming of economic depression as the consequence of falling prices is that the buyer, seeing that goods are cheaper this week than they were last, assumes that they will be still cheaper next week and decides to wait. When we go forth and tell the traveling public that air transport is shortly to be faster, safer, more economical, more reliable, and generally more efficient that it is now, they too decide to wait.

It is not often than anybody can learn anything about public relations from the railroads. They have been notorious for their indifference in that field, but they can give us a lesson here. Almost never does an authorized representative of a railroad company talk about what could be done, or what will be done in the future, or what has been done as a special stunt. There have been occasional declarations, before official bodies concerned with railroad development, that train service could be maintained between New York and Chicago in fourteen hours instead of the present eighteen. The railroad officials have had nothing to say upon the subject publicly, however, and there has been every indication of a desire to avoid turning public attention in that direction.

Every now and then a special train makes a spectacular run between some two cities, in from 20 to 40 per cent less time than the fastest regularly scheduled trip. The interest that lures the train sometimes gives the stunt publicity, but the railroads themselves almost never do. They are afraid that the ordinary traveler might begin to ask why he can't get that kind of service. No doubt there are excellent reasons why he cannot, but it is always unpleasant to have to provide alibis. Why bring the subject up at all?

When automobile engineers meet together they are wont to agree that the cars of ten years hence will be improved out of all recognition over the present models, and that there will be fundamental changes contributing immensely to beauty, to economy, and to ease of driving. When any one engineer, or anybody else in the automobile industry, meets a group of laymen he talks exclusively of the attractions of the car of 1932, and sedulously avoids any suggestion that there might possibly be further improvements in the future.

But in aviation a great many of us habitually depart from those admirable rules. Within the past few months we have heard a speaker, coming from within the aircraft industry, declare that "the safety of air travel will increase 500 per cent in the next ten years." That is so perfect an example of what not to say that it seems almost like a burlesque. If you tell a man that something is going to be 500 per cent safer a few years hence than it is today, he immediately leaps to the conclusion that it must be frightfully dangerous now. American railroads actually did make a 500 per cent improvement in passenger safety between 1900 and 1930, notwithstanding the fact that they were setting up a very good record at the beginning of the century. But any railroad official or employee who had stood up before an audience of traveling men in 1900 and predicted that it would be five times as safe to travel in 30 years as it was then would certainly have been incontinently fired.

Declarations that "within a few years aviation will be the most reliable known form of transportation, and the most completely independent of weather obstacles" may be fine for selling stock in air transport companies, but they constitute a very poor argument for persuading people to make use of this afternoon's airplane. Our customers in the mass are like any other large group of human beings in that they take no account of

promises except to use them as a standard for measuring the apparent inadequacy of present performance We cannot sell a ticket for tomorrow's airplane on the strength of the schedule that we will be maintaining ten years from tomorrow Therefore, let's take it as a fundamental article in our creed that we shall talk a lot more about 1932 and a lot less about 1940

Economy gone wrong

AFTER fourteen years of steady growth and steady improvement of service, the very life of the air mail is threatened The whole structure is in danger of being swept away as an incident to the current economy campaign, and as air mail goes, so goes air transport If every air mail contract were to be cancelled tomorrow the carriage of passengers would not stop, but the airline organization would have suffered a frightful blow Five years hence there will be a very different story to tell in that respect, but for the moment, air mail is the keystone of the structure Remove the keystone, and the structure will totter and part of it will fall

Fortunately, there is little likelihood of a complete cancellation Fortunately, the contracts between the air mail operators and the Post Office Department are, as the Postmaster General has pointed out, in a form which makes them both morally and legally binding upon the government But without going to the length of actual cancellation of contracts, Congress might very possibly cut the air mail appropriation so drastically as to require the cancellation of all extra schedules and the cutting of rates of payment to a point where all the contractors would have to carry the mail throughout the next year at figures well below the minimum possible level of operating costs

The aeronautical world has not given enough attention to, or felt enough alarm over, the air mail appropriation The air mail always has come through all right and continued to grow, and it has been too readily assumed that it always will The dangers that confront it at the moment of writing this editorial, however, are by no means theoretical ones However the battle turns at the moment, it is likely to be renewed in the next session of Congress The interests of air transport in Washington cannot be left to drift They demand the most vigilant protection

If Congress takes action designed to wreck American air transportation, it will not be by inadvertence but by deliberate design It will not be for lack of warning, and distinguished members of Congress have gone out of their way to make it plain that the wrecking of air transport is exactly what they seek Replying to a question bearing upon the possibility of saving 50 per cent of the air mail appropriation under certain identical conditions, the Postmaster General said: "No We will simply wreck the service without getting anything in return—the air mail service would just evaporate." Senator Glass of Virginia, displaying unqualified enmity towards air transport and all its works, asserted: "I think that it is the most extravagant, luxury whim the government ever engaged in . . I must confess that I would abolish the whole system . . . I just think it is an expensive luxury . It is a useless mail facility in my judgment." That is a point of view fortunately entertained by only a very limited proportion of the membership of Congress, but it has to be fought by those who are far-sighted enough to believe in carrying on with the work so auspiciously begun

We said "auspiciously begun," and we stand upon the phrase Despite economic catastrophe and despair, despite a gradual subsidence towards zero of practically every economic activity in every country in the world, air transport makes continued progress. While other classes of postal service fell 10 per cent lower in 1930 than in 1929, and 10 per cent lower again in 1931, the air mail has gone ahead with its steady improvement of 10 per cent a year or better. Passenger service has gained ground even more rapidly. Air transport stands almost alone among commercial enterprises in the United States in its seeming ability to ignore the depression

Very few economic prophecies made nowadays remain good for long enough to allow the ink to dry but we offered one forecast about a year ago upon which we still stand pat We are as convinced as ever that the net cost of the air mail to the government in 1932 will stand as the all-time high From this point forward, the air mail network can be maintained and extended at steadily declining expense. The income will steadily catch up with the outgo, and there will be steady progress towards complete self support The time is not far distant when air transport will be a source of direct revenue, rather than of expense to the federal government, but in the meantime, if that progress is to continue, there must be some discretion in Washington.

We are not among those who oppose all government economy We recognize that the reduction of expenditures is a paramount necessity, and that every activity of the government must be examined for its possible contribution to economy, but there are times and places where undue economy becomes extravagance. An uncompleted building, its unprotected structure left to become the prey of the elements, is always regarded as a monument to folly.

The American people have been engaged, over the past dozen years or more, in building an air transport system It lies, so far as the government's direct contribution to its construction is concerned, within a few years of completion We refuse to believe that the American people, if the issue is thoroughly presented to them will sanction either an abandonment of the structure, with the scrapping of practically all that has been gained, or a serious slowing down of the work at this point

NEWS OF THE MONTH

Records on three continents

FROM an early English spring to late Australian summer in eight days, eighteen hours, and 53 minutes flew Charles William Anderson Scott to regain a record taken from him last November by C. A. Butler. The same Gypsy Moth plane which he had flown from Australia last June carried him back to the Litchfield Airfield at Port Darwin in nine hours, eighteen minutes less than his previous time, which Mr. Butler had bettered by 102 minutes Except for a 101-gal. fuel tank, giving it a range about 1,600 miles, Mr. Scott's plane was a standard model, some 30 miles slower than the Pobjoy-powered Comper Swift in which Mr. Butler covered the 10,500 miles from England to Australia

Only a few weeks after they had celebrated the arrival of Mr Mollison (AVIATION, May, 1932), the inhabitants of Capetown turned out to receive two Frenchmen who had just established another record down the season's most-flown continent MM Goulette and Salel, veterans of a record France to Madagascar flight earlier this year, were the first fliers to reach Capetown from Europe in under 100 hours. Sustained by fruit, twenty bottles of champagne and some concentrated malt, they covered the distance from Le Bourget in three days, nineteen hours fifteen minutes, with only four stops for rest and refueling M. Salel was pilot for the entire flight, while M Goulette did the navigation Their plane, the Marcel-Lalouette, in which they established the Madagascar record, is a Farman 190 powered with a 330-hp. Lorraine engine Mr Mollison, whose time from Lympne, England, twelve hours longer, still stands as the fastest England-Capetown flight flew a 120-hp. Gipsy-powered Moth

With a distance record for autogiros as objective J. N Young, a former Royal Air Force officer, is proceeding in more leisurely fashion towards the capital of the South African Union His C 19 autogiro powered with an Armstrong Siddeley Genet-Major engine is in conformance with British sporting tradition, standard except for additional fuel tanks which give it a 500-mile range.

A trip lacking but a few thousand miles of the distance flown by Post and Gatty to circle the world served as baptism for the tri-engined low-wing monoplane designed by a 27-year-old Frenchman, M Couzinet With 28 hours of flight to its credit before the start from France, the distance to Noumea, New Caledonia, was covered in fifteen stages, six of which were longer than 1,000 miles The 3,000-mile range of the Couzinet, designed to fly at a loaded weight of 7,700 lb was limited by the impossibility of taking off with a full load from airports sodden with the rain which haunted most of the 13,300 miles For the South Seas flight on which Charles de Verneilh was pilot, Max Deve navigator, and M Munch mechanic, Gipsy III 120-hp. engines were substituted for the low-powered French engines with which the plane was equipped when first exhibited at the Paris Aero Exposition in 1930

His flight across the Pacific Ocean from Tokyo to Wenatchee, Wash. with Hugh Herndon on the last leg of their world flight last summer earned for Clyde E. Pangborn the Harmon Aviation Trophy It is awarded annually by the Ligue Internationale des Aviateurs for the outstanding flight of the year.

For his paper "A Study of Airplane and Instrument Board Vibration," read before the S.A.E. meeting during the National Air Races at Cleveland last year, the Wright Brothers' Gold Medal was awarded to Stephen J Zand. Considered the best aeronautical paper of the year 1931, Mr. Zand's work was the result of investigations carried on with the aid of the Vibrograph, a recorder developed by him to obtain accurate data on airplane vibration with a view to its reduction

The first Air Mail Flyer's Medal of Honor, authorized under an Act of Congress early in the present session and to be awarded for heroism and extraordinary achievement in the performance of duties will be presented by President Hoover to Mal B Freeburg of Northwest Airways, Inc. His safe landing of passengers and crew of a multi-motored plane which had lost one of its engines while in the air was the incident for which the recommending committee, of which Assistant Postmaster General W Irving Glover is chairman awarded the medal to Pilot Freeburg who flies the Chicago-Twin Cities route

Calendar

May 27-30	National Balloon Races and Second Annual Omaha Air Races Omaha
June 6-7	Air Show and Dedication of the Albany Seaport Albany N Y.
June 9-10	Pacific Coast Aeronautical Meeting of the A.S.M.E Berkeley, Cal.
June 24-26	International Air Pageant, formal opening of Aviation Country Club of Lake Champlain Westport, N Y
June 25	15th Annual Royal Air Force Display Hendon England
July 8-9	King's Cup Race Brooklands Aerodrome, England.
July 9-11	Second Annual Aviation Country Clubs Invitation Seaplane Cruise.
July 11-24	Third American Soaring Meet Elmira N Y.
July 22-31	Third International Aeronautical Meeting, auspices Aero Club of Switzerland Zurich
July 28	Pre-Olympic Air Show San Diego
Aug 1-6	International Soaring Contest, Wasserkuppe Germany
Aug 11-28	International Air Tour auspices Aero Club of Germany
Aug 19-21	Fourth Annual Canadian Air Pageant, St Hubert Quebec.
Aug. 27-Sept. 5	National Air Races Cleveland
Sept. 6	Aviation Day National Travel Pageant, Atlantic City N J.
Sept. 25 or Oct. 9	Gordon Bennett Balloon Race Basle Switzerland.
Oct. 8-23	Aviation Exhibit 46th Annual State Fair of Texas, Dallas.
November	Thirteenth Aeronautical Exhibition. Grand Palais Paris

"Capetown—all out"

From London to Capetown by air is no longer the exclusive privilege of pilots ambitious for speed or endurance records Since the last week in April anyone in possession of 130 pounds sterling ($480 at present exchange) may leave London with the weekly South African air mail to arrive in Capetown 11 days later, almost a week ahead of the fastest rail and steamship connections Though mail planes have been flying the route since January, passengers were at first carried only as far as Nairobi When the fleet of four-engined monoplane airliners under construction at the Armstrong-Whitworth factory at Coventry are in the air the 8,000 mile journey will be accomplished in nine days

The Inter-Island Airways, Ltd. which since 1929 has been linking Honolulu with the Islands of Hilo, Maui and Kauai on daily and three-day-per-week schedules has now flown 25,000 passengers 650,000 miles with no loss of passengers or personnel The discontinuance of the Transandine Railway service between Chile and Argentina and Uruguay on account of the decline of traffic due to prohibitive tariffs leaves

the Pan-American-Grace airline the only link between those countries Panagra planes have been concentrated in Santiago to meet passenger demands

Coming nearer home, planes are ready to start operation of a new passenger and freight service between Toronto and New York Amphibion planes will be used from Toronto to Rochester, where passengers will change to land planes for the remainder of the distance The schedule calls for two planes a day each way

Passenger airlines in the United States, on which the average fare rate per mile is now reported by the Department of Commerce as 6.29 cents per mile, only half the average in effect at the beginning of 1930, are celebrating anniversaries The thied anniversary of American Airways' air mail route 28 between St Louis and Omaha, on May 1, will be commemorated by the inauguration of a new passenger service between St. Louis and Evansville Ind and Louisville, Ky.

A new night service is also available to St Louis An American Airways plane carrying both passengers and mail leaves there at 10 p.m arriving at 12.33 in Kansas City, where connection can be made at 1 25 a.m with a United Air Lines machine reaching Dallas and Fort Worth at 8 a.m.

Cooperation and cut rates

The Eastern Air Transport system, whose New York-Atlanta line recently completed its fourth year of service, has entered into an agreement for mutual cooperation with the Greyhound Bus Lines By this agreement, similar in many respects to the arrangements made between the bus company and Transcontinental & Western Air, each system will act as agent for the other, permitting joint traffic promotion, joint tariffs and a coordination of schedules giving rapid connections with the nearest airport of call to communities within 100 miles of the 27 cities served by the Eastern Air Transport.

Announcement of pay increases, restoring to all ground employees the wages reduced early last winter, has been made by the Ludington Lines, operating an hourly passenger service between Newark and Washington. No less remarkable is Ludington's new half-rate now applying to its four morning planes. A special student ticket purchasable for five dollars, secures any seat not taken immediately before the departure of the plane for Washington. This brings air travel, on an if-space-available basis, down to 10 per cent below day-coach rates.

Aeropostale has received an extension of its time limit for the establishment of a four-day mail service between Argentina and Europe According to the new contract the reduction in the time required for the weekly trip from seven and a half to four days (which will require trans-Atlantic flying in place of the high-speed boat service between Dakar and Brazil), need not be accomplished until March 1, 1934

Acme

ON AGAIN — OFF AGAIN

A Navy Fleet hooked to the Akron's airplane attachment device Note the opening in the bottom of the hull by which the plane may be lifted into the "hangar"

Red army in the air

Climax to the May Day celebrations in Moscow in which more than a million workers marched was a parade of 275 army airplanes in formation, all types of planes from four-engined monoplane bombers, the most recent Soviet aeronautical development, to light pursuit craft A single airship represented the lighter-than-air fleet which it is planned to produce on a large scale under the direction of Comrade Pourmal. A plant scheduled for completion by the fall, is under construction near Moscow Umberto Nobile, commander of the Italia on its flight to the North Pole in 1928, has contracted to assist in the design and construction of airships to be the basis for an extensive transport network to carry passengers, mail and perishable goods throughout Russia

The May Day display shed some light on the vexed question of the size of Russia's air force Attendant circumstances suggested that as many planes as possible had been put into the air, and that the 275 planes were fairly comparable, as a measure of strength, with the 672 assembled for the Army Air Corps maneuvers last spring On that basis, the Air Corps would appear about twice as powerful as the Russian force

The aeronautical budgrt of the Soviet Union for the current year totals almost $33,910,000, estimating the ruble at about 20 cents Well over half this amount is allotted to new construction which under the new five-year plan is scheduled to include 1155 airplanes at an average cost of $16,500 and 42 lighter-than-air craft during 1932. If the Russian force is now only half as strong as that of the U S Air Corps, the Russians apparently intend to narrow the gap.

From the Soviet's eastern neighbor come rumors of the formation of an escadrille squadron of foreign pilots, similar to the Lafayette Escadrille organized in France during the War Early installments of a group of 50 planes purchased by Chinese residents in this country to equip this squadron which is being sponsored by the chief of the Cantonese Air Forces, perhaps as insurance against the variable political allegiance of native pilots, have already begun to arrive. More than 80 foreign pilots in addition to the unemployed Canadian Air Force officers who offered their services to China several months ago are said to have applied for places in the squadrons, which present plans limit to 36 planes. While a considerable number of foreign pilots, largely American or German, are already in China training students or flying mail and passenger planes on Chinese air routes, their contracts expressly forbid participation in hostilities, civil or otherwise

Aircraft carriers under fire

The most recent consideration by the Disarmament Commission at Geneva of aeronautical affairs has centered around aircraft carriers, and whether or not they are "aggressive weapons." The suggestion by the French delegation to reduce the tonnage of aircraft carriers was contingent upon the abolition of bombing planes, which would make smaller vessels sufficient for scouting operations Senator Swanson maintained that neither action should be taken without the abolition of submarines, against which bombing aircraft are essential While objecting to the American delegate's connection between bombers and submarines as not being substantiated by War experience, the German delegation agreed with Italian and Soviet representatives that bombing aircraft and carriers for their accommodation should all be abolished as aggressive.

Bombing planes were among the cast of 300 aircraft and 104 surface vessels in the force-firing practice which the U S Fleet, rested after its Pacific games, staged off San Clemente Island in mid-April. One hundred airplanes from the carrier Lexington, which is being overhauled, joined forces with planes attached to the Saratoga and the Langley and with 70 scouting planes catapulted from battleships and cruisers in a heated attack of which the battleships were the center

A 435-mile flight over the mountains from the Consolidated Aircraft Corporation plant in Buffalo via the Susquehanna valley brought the monoplane flying-boat XP2Y1, the Navy's most recent experimental purchase, to Anacostia Air Station for routine performance and acceptance tests Maintaining an altitude of 5,500 ft., the flight was made in three hours, ten minutes with six persons on board. Largest flying boat in navy service, the XP2Y1 is powered with three 600-hp Wright Cyclone engines It is the first of an order of 23, to cost about $175,000 each

Also from Buffalo came the new Curtiss single seater fighter F9C 2, powered with a 400-hp. Wright Whirlwind engine and equipped for landings and take offs from an airship's trapeze An identical plane was exhibited for the first time at the recent Detroit Show Two of them left the ground at Lakehurst just after the Akron left for the Pacific coast, flew after the ship, hooked onto the trapeze, and were drawn up into the "hangar" within the hull

Another order of F4B-3 Boeing pursuit planes has just been delivered to the Navy for the use of its High Hat Squadron. Powered with 575-hp. Wasp engines having a special compression ratio of 6-1 and 12-1 supercharger, they have a top speed of almost 200 m p h. all the newest equipment for navigation, and emergency flotation gear

The Akron flies West

Completely recovered from its damages of Feb 22 and equipped with new propellers and gear for handling its brood of five airplanes, the U S S. Akron on May 8 made its belated departure from Lakehurst to join the fleet maneuvers on the Pacific coast Three preparatory flights, a general test flight, one to take members of its Congressional investigating committee for a ride, and another for speed trials proved its airworthiness Bad weather en route gave a far more severe test, but the ship rode successfully into the Sunnyvale station (near San Francisco) after an intermediate stop for re-fueling at Camp Kearney, near San Diego.

The Goodyear Tire and Rubber Company, builders of the Akron and in whose Akron dock the construction of its sister ship Macon is well under way, have leased part of the Pal-Waukee Airport near Chicago to build a dock for the use of non-rigid airships Goodyear's fleet of six, the only privately-owned squadron of airships in the world, operates largely from Los Angeles, Gadsden (Ala), Akron, and New York Used also for aeronautical and meteorological research, the six airships last year carried about 40,000 passengers on short flights, building up a clientele for the passenger lines to Europe and the Orient which it is planned to inaugurate if governmental aid is secured by the bills now pending in Congress.

The arrival of eighteen new Curtiss P6E pursuit planes at Selfridge Field, Mich , to equip the 17th Pursuit Squadron for active service made possible the completion of the first group problem for 1932 by the First Pursuit Group stationed at that field

The Air Corps will keep warm next winter even at 40 deg below zero The old "Monkey" flying suit which did not satisfactorily resist temperatures of much less than zero, weighed as much as 16 lb, and was appallingly clumsy, is to be replaced by a two-piece suit of horsehide and lamb shearing which is not only lighter, but warmer and better fitting, and completely equipped with zipper fastenings The two-piece flying suit will also be made of a lighter fabric for summer wear

The pinch of economy is causing considerable retrenchment on the part of the Army Air Corps. Maj.-Gen. Charles H Bridges, the Adjutant General, recently announced the postponement until 1934 of the completion of its five-year construction program, scheduled for this year, and other adjustments. Albrook Field, Panama Canal Zone, opened early in May, will be the base for only two pursuit squadrons The formation of the 20th pursuit group, for which new barracks and quarters had been constructed, is postponed until 1934, as is the formation of two additional pursuit squadrons for Hawaii. The pursuit groups planned for Barksdale Field (Tex.) and Langley Field (Va) will be formed from the units now at Mather Field, which is to be closed, and from the additional pursuit squadrons now at Selfridge and Brooks Fields. The deferred plan will leave the army about 100 planes short of its goal of 1,800

THE LATEST BLIMP

The Resolute, most recent of the Goodyear-Zeppelin line, was test flown April 25 It carries five passengers and two pilots

Manufacturers make hay

The British aeronautical industry, which in 1931 again led the world's export trade in flying material, still finds its best customers on the home ground Re-equipment of the R.A.F. is a large item: new Vickers Vildebeest biplanes go to one torpedo bomber squadron, Hawker Audax two-seater fighters replace the Atlas biplanes of an Army co-operation squadron, while the Nimrod single-seaters by the same manufacturer, among the fastest naval fighters in the world, replace the obsolescent Fly-catchers of a marine squadron

British export totals for 1932 will be further swelled by an order of 26 Vickers Vildebeest torpedo planes for the Spanish naval air service. One of the 600-hp biplanes was ferried from Brooklands aerodrome to Madrid, while the other 25 will be built under license in a factory at Cadiz.

The Junkers plant at Dessau recently completed a J52, powered with three Hispano-Suiza engines giving a total of 1900 hp., for Prince Bibesco, present president of the F.A.I. The Junkers G38 transport plane which last summer flew the Berlin-London route has spent the winter receiving a new flooring, giving it 30 passenger seats with window view, and four new L88 engines of increased power With another plane of the same type, it will be put back into the Lufthansa service this summer.

Wright Whirlwinds built under license

will power the new four-passenger high wing monoplanes which are being turned out by the Plage and Laskiewicz factory in Poland for use on the national air lines They replace the Junker F13's which have been running on the Polish lines for about ten years

Lockheed aircraft, two of which were recently sold to Swiss-aire, operators of passenger lines in central Europe, will in the future be distributed to the foreign markets through the Curtiss-Wright Export Corporation Through arrangements with the Lockheed Aircraft Corporation and its receivers Curtiss-Wright will also handle the distribution of Lockheed monoplanes to the domestic market

American airport equipment may find a market in Gothenburg (Sweden) Airport Director Capt. Gosta Andree, in charge of the airport construction plans of that city, plans to visit the United States shortly to study airports, lighting systems and lighting equipment before initiating the expenditure of a $465,000 corporation

Two Bellanca Pacemakers form the basis of an air force being established by the Dominican Republic, with Maj Jose Figueroa as Chief of Air operations Powered with Wright Whirlwinds, the planes were flown from Newcastle to their home field near Santo Domingo

Speeds of over 200 m p h will characterize the planes which the Beech Aircraft Company, organized by Walter H Beech after his resignation as president of the Curtiss-Wright Corporation plan to present to the public At the erstwhile Cessna factory in Wichita the Beech company will build two models, a two-passenger plane with a proposed top speed of 230 m p h and 1 000 mile cruising range and a four-seater, slightly less speedy, with a 500-mile range Both are being laid out with special eye to comfort.

The Stinson Air Cab Operators' Association, organized last winter to serve the interests of independent flying service operators held its first meeting during the Detroit show As a clearing house for methods of stimulating community interest in air taxi service air touring, storage and servicing of planes and other airport activities and through its promotional work the association serves its 59 members

Parks Air College, of East St. Louis, has taken over the Van Hoffmann Air College heretofore its most serious competitor within a 300-mile radius

Aeronautics before the states

The material immediately following together with reference to legal and legislative matters elsewhere in the news pages is based largely upon the Aviation Law Service prepared by the Commerce Clearing House, Inc. AVIATION is licensed to make use of the service and is able to give its readers the benefits of the work of an organization specially trained and equipped to insure the complete collection of pertinent material on current legal developments

State legislatures have been particularly active this spring in providing for the regulation of aeronautics within their boundaries The General Assembly of Kentucky, repealing an earlier statute, has provided a new law under which a new Air Board of five members, including the Governor, is created Operating under the Military Department, with the state's Adjutant General as executive head this Air Board is directed to promulgate the necessary air traffic rules and to require Department of Commerce licenses of all aircraft and pilots operating in the state In addition both pilots and planes must be registered with the Air Board at an annual fee of $5, presumably to finance the construction by the board of airports and airway facilities

Department of Commerce licenses also became obligatory for New Jersey pilots and aircraft with the recent amendment of the powers of the Aviation Commission The amendment restricts certain methods of airport marking to fields which have secured the permission of the Commission, which is also prerequisite before any passengers may be carried for hire or aerial exhibitions held at airports in the state

Virginia has acted to protect and assist aircraft operators by including airplanes in the statute which protects lessors from the reckless or fraudulent use of their vehicles or animals when hired, and by providing for the refund of taxes on gasoline when it is to be used in aircraft.

Transport pilots get a rating

An amendment to the Air Commerce Regulations, developed in a conference between the Department of Commerce and representatives of airline operators and pilots, becoming effective May 5, will make a scheduled Air Transport Rating mandatory for all pilots flying in scheduled interstate air passenger transportation after Jan 1 next year Requiring 1,200 hours of solo flying, 500 hours of which must have been cross-country flying within eight years previous 75 hours of night flying partly on lighted airways and the ability to fly entirely by instruments, demonstrated to a Department inspector, while flying in a hooded cockpit, the rating indirectly requires the equipment of planes in passenger service with the instruments necessary for blind flying Most pilots now flying on scheduled passenger airlines are probably already capable of filling these requirements though none of them are obligatory for a transport pilot under the present regulations

The Professional Pilots Association organized in 1923 by a group of California pilots headed by Gilbert G Budwig, now Director of Air Regulations, of the Aeronautics Branch, is planning an expansion drive. Its original purpose of securing measures governing the qualifications of pilots and the airworthiness of planes having been largely achieved in the Air Commerce Regulations, the association continued to cooperate with the Department of Commerce in matters concerning pilots, has functioned as arbitration body in disputes between pilots and employers, and promoted the cause of aviation in local legislatures To organize on a national scale all pilots for whom flying is a profession is the aim of the present campaign

Production and transport pays

An innovation in the first quarterly report of the Curtiss-Wright Corporation and subsidiaries for the year 1932 is a net profit, after depreciation interest, taxes and other charges of $302 013 Equal to about 26 cents a share on 141,214 Class A shares outstanding, this is to be compared with a loss of $1,088,124 during the same period of 1931 The net profits reported by its two principal subsidiaries, Curtiss Aeroplane and Motor Company and Wright Aeronautical Corporation were $96 700 and $334,724 respectively For the first three months of 1931 the two companies reported losses of $46 515 and $356 859

United Aircraft and Transport Corporation earnings for the first quarter of 1932, were $441,445 after taxes, depreciation, and minority interests After deducting $180,000 for preferred dividends this was equal to 12 cents a share on 2 084 319 common shares outstanding For a similar period last year the net income was $806 648 or 30 cents a common share National Air Transport, one of United's transport subsidiaries which in the first quarter of 1931 earned $117,579, or 18 cents each on 650 000 no par capital shares, for the current year reported a net loss after expenses, taxes and other charges of $6,750 Gross revenues from United Airline's operations during the first three months of 1932 were $2 041,425 a mere 1 per cent below the 1931 figure However, passenger revenues during the quarter just passed showed an increase of almost 80 per cent over the same period of 1931, while the number of passengers carried more than doubled Passenger revenues this year were $290,159, or 14 per cent of the total transport income. In the first quarter of 1931 passenger business accounted for but 8 per cent of the gross

Aviation Corporation stockholders at their annual meeting voted to change the listing of their stock on the New York exchange Application has been made to give to the 2 831 041 no par capital shares a par value of $5 each Of the capital stock outstanding about 500 000 shares are now held by the Cord interests which have increased their holdings recently acquired through the

sale of the Century lines by purchases in the open market and from holding companies, at a reputed cost of about $1,750 000 E L. Cord and L B Manning are newly-elected members of Aviation Corporation's board of directors

The annual report of Canadian Airways, Ltd. for 1931 shows a net loss, after providing for depreciation charges, of $263 830 The net loss in the year ended Dec 31 1930, of the combined companies which had merged in the latter part of that year was $68 704 Total mileage during 1931 was reduced by about 8 per cent from the previous year's figure while total operating revenues dropped 22 per cent

The creditors of the Junkers company, whose financial difficulties were recounted in the May issue of AVIATION, and the city of Dessau (Germany), in which it is located, have become its chief backers In an effort to continue the operation of the Junkers aircraft plant they have formed a limited operating company However, government aid continues to be the source to which its management looks for means to pay the 3,000 employees and purchase raw material for the completion of planes now on order

N.A.A. checks up on racing

In an endeavor to develop air racing in this country on a permanent basis the Contest Committee of the National Aeronautic Association is following a policy of insisting on proper sanction of all contest events which is securable in written form upon registration with the N.A.A of evidence that the meet will have adequate financial backing and proper management. F.A I pilots have now been warned that participation in unsanctioned racing events will be at the risk of fines or suspension or both To aid pilots interested in participating in air meets and manufacturers engaged in building special racing and demonstration planes, advance information is being collected on races, airport dedications, tours and aeronautical contests planned for the coming year Participation in these meets will be denied pilots found guilty of having taken part in an unsanctioned event

No N A A sanction is required for aeronautical events involving no competitive flying but the Chamber of Commerce takes a hand The Southwestern Aviation Exhibit, to be held in connection with the State Fair of Texas next October, has the proper Chamber sponsorship The Aircraft Show, to be housed in the Automotive building, will give manufacturers an opportunity of reaching a large portion of the population of an area where flying conditions are favorable much of the year

At a recent dinner meeting of participants in last year's Annual Aviation Country Clubs Invitation Seaplane Cruise, Charles L Lawrance and George B Post were re-elected Commodore and Fleet Captain respectively, and a regatta committee which included them and three others was appointed Details of the itinerary of the forthcoming cruise, to be held July 8 to 11, were left to the committee which will use as a basis a tentatively approved schedule including Newport, Cape Cod, and the Aviation Country Club of Champlain at Westport, N Y

The Soaring Society of America, Inc., of which Warren E Eaton is president and Edward P. Warner board chairman has announced that the third annual soaring meet in this country will be held at Elmira, N Y., July 11 to 24 The society, organized for the purpose of assuring a 1932 soaring meet, was formerly designated as the American Soaring Association, a name found to have been already selected by a commercial group.

Several additions have been made to the directorates of air transport companies. Robert A Lovett, a partner in the firm of Brown Brothers-Harriman was elected to fill a vacancy on the board of American Airways, operating subsidiary of the Aviation Corporation To the board of United Aircraft and Transport, reduced from eighteen to sixteen members, were elected E E Wilson and D. L. Brown the latter recently made one of the vice-presidents of the company

Comdr Archibald H. Douglas, at present serving on the U S S Saratoga will be transferred to the command of the U S S Langley.

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Aviation before Congress

Developments of the past month (See AVIATION for May, page 236)

The bill	Number	Its history
A bill to regulate interstate commerce by air carriers operating as common carriers of persons and property (Cable Bill)	H R 11291	Similar to the Bratton Bill (S 24841 introduced into the Senate earlier in the session and awaiting the consideration of the Senate Interstate Commerce Committee It would require every interstate air carrier to obtain a certificate of public convenience and necessity authority to issue which would be vested in the Interstate Commerce Commission
A bill to abolish the office of Assistant Secretary of the Navy for Aeronautics	H R 11333	Introduced by the Chairman of the Committee on Naval Affairs and referred to his Committee which voted unanimously to recommend it to the House following the testimony of Secretary Adams that the step could be taken without impairing the efficiency of naval aeronautics
A bill to abolish the office of the Assistant Secretary of War for Aeronautics	H.R 11334	Referred to Military Affairs Committee which has as yet made no report
To safeguard the rights of air mail pilots in collective representation. (Capper Resolution)	S.J Res 132	Referred to the Committee on Post Offices and Post Roads Like H J Res 345 (Aviation May page 237) it would enable the Postmaster General to require the recognition by all air transport operators of the rights of their pilots to collective bargaining and representation Proposed penalty for recalcitrance on the part of the companies is also identical—the cancellation of contracts or certificates held by the operators
(Mead Resolution)	H Res 134	
A bill to confer certain benefits on commissioned officers and enlisted men of the Army and Navy Marine Corps Coast Guard Geodetic Survey or Public Health Service of the United States who are placed on the retired list for physical disability as a result of an air plane accident (Copeland Bill)	S 4270	Referred to the Committee on Military Affairs which has as yet submitted no report

(Continued on page 278)

(Continued from page 277)

The bill	Number	Its history
To regulate the conduct and administration of military organs Air Corps depots, and other War Department activities and property. (Reed Bill)	S 2378	Provides authorization for the use of aeronautical equipment at Wright Field for research purposes by private manufacturers and designers, under bond and providing they defray any expenses involved in the experiments. Reported to the Senate by the Committee on Military Affairs it has been passed and referred to the House committee
To provide for an annual appropriation to meet the quota of the United States toward the expenses of the International Technical Committee of Aerial Legal Experts (Linthicum Resolution)	H.J Res 193	Introduced early in the session was referred to the Committee on Foreign Affairs, Was reported to the House without amendment but has not as yet reached the floor
To amend the Railway Labor Act of May 28 1926 (Bingham Bill)	S 4458	Would place labor controversies arising between air transport companies and their employees within the jurisdiction of the Federal Board of Mediation extending the application of the procedure already established for rail carriers by the Railway Labor Act. Referred to the Committee on Commerce where it awaits consideration
To amend the act entitled 'An Act to provide more effectively for the national defense by increasing the efficiency of the Air Corps of the Army of the United States and for other purposes.' (Mead Bill) (Reed Bill)	H R 11249	Identical bills introduced into the two branches of Congress within a week of each other by Representative Mead and by the Chairman of the Senate Military Affairs Committee would make it possible for the services, after new and improved equipment has been developed as the result of experimental purchases to buy such equipment in quantity from the originating individual or corporation without advertising for competitive bids. Would also waive the curious restriction in the procurement act of 1926 under which quantity purchases can be made by negotiation for equipment developed prior to 1926 or minor modifications thereof, but not for anything brought out after that date. Write attention from the appropriate committees.
To develop American air transport services over seas, to encourage the construction in the United States by American capital of American airships for use in foreign commerce and to make certain provisions of the coastwise law applicable to foreign commerce by airship (Crosser Bill)	H.R 8681	Providing liberal mail contracts, limited liability and legal status for airships as carriers almost exactly as present law provides them for steamships it has the approval of the Bureau of Aeronautics of the Navy, the National Advisory Committee for Aeronautics and the Aeronautics Branch of the Department of Commerce. With two amendments; one extending to metalclad airships the provisions for mail subventions and the other specifying the percentage of the personnel which must be citizens of the United States the bill has been favorably reported to the House by the Committee on Interstate and Foreign Commerce
To initiate a new Maritime Code of the air for aircraft flying in international trade following the line of steamship legislation. (McNary Bill)	S 4262	Almost identical with the Crosser Bill this also has been reported out of Committee with modifications. There is no indication as to when it may be taken up by the Senate
To organize a department of national defense (Byrns Bill)	H R 7012	Proposal to consolidate the departments of War and Navy after being lobbied by the Committee on Expenditures in Executive Departments, was introduced again as a feature of the Omnibus Economy bill. Suffered the rejection characteristic of the House's treatment of that measure; after a stormy discussion, and is probably dead for the life of the present Congress
Navy Department Appropriations Bill	H.R 11403	Appropriations for the Bureau of Aeronautics, cut by the budget to 79 per cent of the 1932 figure, were further reduced $1 271 000 by the House Committee to $23 188 000. The allowance for new aircraft is $5 600 000 instead of $11 680 000. This bill was passed by the House practically as received from the committee with the notable exception of the item concerning flight pay of Naval pilots. The limitation of flying extra pay to a yearly maximum of $1 600 provoking violent opposition was removed upon the assurance of Admiral Moffett and Secretary Adams that the same reduction of expenditure of $871 800 would be made by refusing flight orders to officers whom duties do not make flying absolutely essential
War Department Appropriations Bill	—	Recommendations of the Committee for 1933 Air Corps appropriations leave practically intact the budget estimate. Out of a total allotment of $23 483 000 the allowance for new airplanes is $11 526 728, of which $9 017 152 must be used exclusively for combat planes. An additional appropriation of $1 165 237 is made for the purchase of planes for the Organized Reserves and the National Guard. A reduction of $113 000 in flying pay is required, the application of which is left to the discretion of the Chief of the Air Corps as is the case of the similar Naval reduction. The bill has passed the House, and now faces the Senate rule on-all 10 per-cent system
Post Office Department Appropriations	H R 11103	Appropriations of $7 000 000 for foreign air mail and $16 000 000 for domestic contracts after approval by the House were reported to the Senate which instructed its committee to apply further cuts of at least 10 per cent. Hearings before the Subcommittee of the Committee on Appropriations under the chairmanship of Senator Oddie of Nevada have included suggestions ranging from complete cancellation of contracts or that being impossible a 50 per cent reduction in the number of schedules to the appropriation of several additional millions to provide further extensions of route. Senator Glass of Virginia tough minded financial wizard of the Senate enlivened the hearings by sweeping denunciations of the whole air mail system as an unqualified waste of government money. The Postmaster General has taken a flat position that a reduction of 10 per cent or any other amount should be made elsewhere than in the air mail allotments and that no subsidy cuts there are possible without wrecking the service or violation of contracts that are both legally and morally binding upon the government. The hearings continue with no immediate prospect of a report to the Senate which has been requested in a resolution put in by Senator Oddie in rescind its mandate for the 10 per cent cut

SIDE SLIPS

By Robert R. Osborn

WE ARE still having the greatest difficulty in convincing newspaper men that accuracy is of particular importance in reporting aeronautical events as a word or two misplaced may change the true meaning of the entire article. Take, for example, the item in the Buffalo *Evening News* about the American girl who was the first to fly a Soviet-built airplane, from which item we quote as follows: "Although accompanied by a Russian pilot, Miss G. had complete charge of the controls during two of four flights. She did five loops and a number of vertical banks and sideswipes. 'You'll do,' the Russian pilot said with a smile after the final flight."

We should have thought that it would have been obvious to the reporter that

when the pilot said, as soon as he had recovered his breath after the last sideswipe, was, "That'll do."

Mr. F.A.W. of Buffalo, directs our attention to the definition of an "aviator" which appeared in *The Aeroplane* of England, and we take the liberty of reprinting it just to show youse guys in the back row who are doing most of the complaining, that conditions could be better almost anywhere on the globe:

"An aviator is one who works all hours of the day, year in and year out, and who eventually by his hard work reaches a state of abject poverty."

Also from *The Aeroplane* we note an interesting bit of news concerning airline operations in England, this item being taken from the very clever column of comment therein signed by one "Spry":

"By the way, the latest improvement in airline operation is the erection of flagstaffs on certain airliners from which float Civil Air Ensigns. The machine taxies from the tarmac with colours flying and halyards humming and then rather disappointingly strikes its colors before taking off. At the other end all is bustle and confusion among the crew, for the flag has to be run up again. Somebody ought to write the first 'Air Chanty' to be sung by the crew when sweating and straining at the halyards. The pilot's room would probably supply an assortment of robust and rollicking legends of the sort of which sea chanties are usually made."

It seems to us that here is an excellent idea for American air transport lines to adopt, except that we do think the ensign should be left flying throughout the flight. Think of the splendid code of signals which could be worked up, and consider the beautiful aeronautical etiquette which could be developed,—patterned after the present marine codes! The following signals occur to us, offhand, as being appropriate and we offer them as first suggestions:

Ensign at half staff. Half of the rated horsepower of the engine is dead. Proportional distances down the staff to the ensign could indicate the number of cylinders which have ceased to function.

Ensign dipped three times in rapid succession. Both pilot and co-pilot are reading the financial pages of the *Herald-Tribune*, and as the ship isn't particularly stable the passengers are having a tough time of it.

Ensign inverted: Ship has turned over on landing on the muddy field.

Fifteen different flags all flying from the one mast. If on an airplane running down the field, would indicate that the pilot is very forgetful, and as he

probably won't be able to get off, you might as well phone for the repair truck immediately.

Ensign with black marks on a white or crimson field. Black marks would indicate number of times the pilot has been caught by the Department of Commerce inspector. After three black marks on a white field would entitle the pilot to a crimson field. Three black marks on the crimson field would give the Department of Commerce permanent possession of the pilot.

A French inventor has recently been experimenting with crash-proof cockpits for airplanes, based on an experiment he made with some eggs. It seems that by some process beyond our comprehension he placed a hen's egg inside of an ostrich egg, and discovered that when this combination was dropped the ostrich egg was smashed but the hen's egg emerged intact. Even if his devices work as well as he promises we are sure that the new development will never be popular with aeronautical folk, because

of the natural resentment that experiments with eggs should have suggested aeronautical developments to the inventor.

Speaking of eggs reminds us of the warning recently that more substantial packages must be used in sending eggs by air transport, and that the nature of the contents must be plainly marked on the outside of the package. It seems to us that a very good story might lie in back of this warning, and we should be glad to hear from anyone who knows the full details of what happened to the fellow who missed catching the package, and to the fellow who threw it.

The reports are very interesting that the tests of carrying fighting airplanes within a hold in the Akron were successful. We quote one reporter's account:

"Today's tests marked the first time an airplane had ever been carried aloft inside a dirigible, launched and picked up in midair. Soon five of these machine-gun-equipped midgets will nest in the interior of the Akron. . . . Previously airplanes have been able to hook on to the dirigible Los Angeles, deliver messages and drop away, but no plane has ever before been able to call the maw of a dirigible 'home'."

So, you see, we now have the aeronautical equivalent of the old matrimonial gesture of "going home to maw" after a fight.

(Note to Editor: If a lot of the customers complain about this, explain to them that we don't often use this type of humor. Anyway, this is a special case as this pun is really good.—R.R.O.)

(Note to R.R.O.: I don't think this pun is good.—E. P. W.)

(Note to Editor: I still think it's good—R.R.O.)

(Note to R.R.O.: Well, you can take the chance. However, if a lot of subscribers complain,—you know the advertising manager has been asking for your page for a long time.—E.P.W.)

FLYING EQUIPMENT

Stinson's new Airliner

HARD on the heels of the Model R Junior (AVIATION, March, 1932, page 148) recently announced by the Stinson Aircraft Corporation of Wayne, Mich., comes their new Airliner exhibited for the first time at the recent Detroit Aircraft Show

The short lower wing stub, used to support the landing gear of the smaller machine appears again in the new Airliner, although its usefulness has been further extended by making it carry not only the landing gear but also the outboard engine nacelles This arrangement permits the mounting of the outboard engines well below and well ahead of the wing, increasing both propulsive efficiency and wing efficiency, and also reduces interference drag From a structural angle, it takes all the engine loads and vibration away from the wing structure, and eliminates the usual network of struts required to suspend nacelles The landing gear attachment is less complicated, and the stubs provide a very direct and simple method of getting engine controls and engine instrument connecting leads from the outboard nacelles into the cockpit They also afford convenient and practical housing for passengers' baggage.

Based on data collected from the operations of the original Model "T" airliner on both the Ludington and Century lines, the changes made in the Model U point definitely in the direction of increased comfort for passengers and increased economy of maintenance Noise in the cabins has been materially reduced by the addition of more soundproofing in the walls and by the elimination of propeller overlap. Cabins have been widened 7 in and additional headroom has been provided The elimination of baggage in the fuselage proper has permitted better spacing of seats so that more leg room is available A newly designed ventilating system changes the air in the cabins completely every four minutes, and for winter flying warmed air for the heaters is provided from all three engine exhausts. Lowering the nacelles and eliminating struts which formerly crossed through windows, has improved passenger vision materially.

In the pilot's compartment the windshield has been modified to a V-type with sliding windows, which give unobstructed forward view in bad weather and at the same time protect the pilots from a rush of air or rain The relationship of instrument board and windshield has been carefully studied to eliminate reflection at night. All instruments, including those for the outboard engine, are installed in the pilot's compartment on indirectly lighted panels Controls for the adjustment of both vertical and horizontal stabilizers flare releases, landing lights, radio, fire extinguisher control and gasoline valves are disposed within easy reach of the pilot All flying controls are mounted on ball bearings Brakes are operated from heel-type pedals in conjunction with the rudder, and a parking brake is also provided.

Aside from the obvious changes centering around the wing stubs and modified engine mountings, a distinct improvement in external line may be noted Wing tips have been rounded off slightly, generous fillets provided at all intersecting surfaces, and a generally pleasing streamline effect from nose to tail has been achieved. Maintenance problems have been simplified by a careful study of parts for accessibility and interchangeability.

Waco Model A

Stinson Airliner

Kellett convertible

The general specifications of this airplane as given by the manufacturer follow: Capacity, ten passengers, one pilot; power plant, three Lycoming R 680s, 720 hp, (total), span, 66 ft, length overall, 43 ft 2 in., height overall, 11 ft 6 in; wing area, 574 sq ft.; weight, empty, 6230 lb; useful load, 3070 lb., gross load, 9300 lb., wing loading, 16 2 lb per sq ft; power loading, 12 9 lb per hp

Waco Model A for the sportsman

WACO of Troy is making its 1932 bid for sportsman pilots' patronage with the new Model A biplane The requirements of the private flyer who wants to "go places and do things" have been the primary consideration in the design Side-by-side seating for two people is standard, thereby making available ample space and weight carrying capacity for a considerable amount of luggage In addition to these features a detachable "winter top" enclosure may be purchased for this airplane, which offers complete protection to the occupants of the cockpit in all kinds of weather without entailing the sacrifice of good visibility or performance.

The machine is a staggered biplane powered with a radial engine. It has been stressed for power plants, ranging from 100 to 200 hp and is being offered with the Kinner K-5, B-5 or R-5 engines, the 110 hp Warner Scarab, or the 165-hp Continental engines Fuselage, wings and tail construction are conventional throughout both as to materials and arrangement The landing gear is the Waco semi-enclosed split axle type introduced for the first time at the 1931 Aircraft Show

A convertible Kellett autogiro

A NEW autogiro, similar in appearance to the previous Model K-2 but involving a number of changes made on behalf of performance and passenger comfort, is being exhibited by the Kellett Autogiro Corporation of Philadelphia, Pa. The new machine is designated as the K-3, and was on display at the recent Detroit Aircraft Show

One of the major changes involves the power plant, a 210-hp Kinner engine having been substituted for the former 165-hp. engine. Extensive tests have also furnished data from which propellers have been readjusted to give marked improvement in propulsive efficiency. Tail surfaces have been redesigned to bring more of their effective areas within the slipstream, and changes have been made in the undercarriage to give a greater ground angle to the machine when at rest.

From the standpoint of passenger comfort, the detachable cabin enclosure over the cockpit makes it an all-weather machine. Engine vibration and noise have been materially reduced by mounting the engines on rubber bushings and by carrying the exhaust manifold well below the fuselage Cowling of the automobile type is provided around the engine to give complete accessibility for inspection or adjustment The side-by-side seating arrangement has been retained.

Brief specifications as given by the manufacturer follow: Rotor diameter, 41 ft, fixed wing span, 26 ft, length of fuselage, 19 ft 6 in; height over pylon, 12 ft. 7 in

A light cabin type, the Fairchild 24

DIRECT appeal to the owner-pilot whose requirements may be met by a light cabin type airplane for two people characterizes the Fairchild 24, recently produced by the Kreider-Reisner Aircraft Company, of Hagerstown, Md., a division of the Fairchild Aviation Corporation Seating arrangement, instrument board and the view forward over the cowling simulates very closely familiar automobile practice.

The fuselage which is of conventional steel tube and fabric construction, is 40 in. wide at the cabin section, with the seats extending the full width The use of square tubing in the fuselage facilitates the fitting of cabin doors and cowling

The controls are of a simple design permitting the installation or the removal of a dual set in four or five minutes The two sticks are mounted on a single torque tube supported in cast aluminum bearings attached directly to the fuselage structure The aileron torque tube runs at right angle to the elevator tube and is controlled by a ball-type joint which allows complete freedom of movement in all directions. Rudder pedals are mounted on a pair of torque tubes, supported on ball bearings, and operate the rudder through cables A stabilizer adjustment crank is located overhead

The strut-braced monoplane wing is in two parts Each panel has rounded tips and tapers down at the root at the point of attachment to the fuselage. This feature permits greater visibility from the cabin, greater height in the doors, and improved streamlining as the fuselage does not have to be built to fit the wing curve. Ailerons extend the full length of the trailing edge of each wing, and are built entirely of metal. The torque tube is an integral part of the aileron structure. This arrangement permits a simple and direct means of making connection to the control stick without the use of bell cranks and pulleys Right and left-hand ailerons are interchangeable Each is supported at the fuselage and by self-aligning ball bearings

The tail surfaces, except for the fin which is built of wood, are of steel tube construction covered with fabric Elevators and rudder are interchangeable. The stabilizer is externally braced by means of streamline tubing An unusual feature is the extremely high aspect ratio of the tail surfaces. It is claimed that this makes an unusual smoothness of control possible, even at stalling speed The landing gear is of the split axle type, of relatively wide tread The shock absorbing system includes both the semi-balloon tires and oleo shock struts Brakes are standard equipment A full castering pneumatic tail wheel is also provided.

A Cirrus Hi-Drive engine developing 95 hp is fitted This type of engine permits good cowling arrangement forward, and by carrying the exhaust below the fuselage, keeps the noise level down in the cabin

Specifications for the Fairchild 24 as given by the manufacturer, are Span, 35 ft. 8 in., length overall, 23 ft. 2 in; height overall, 7 ft., wing area (including ailerons), 170 sq ft., weight, empty, 1030 lb., useful load, 570 lb., gross weight, 1600 lb., wing loading, 9 4 lb per sq ft power loading, 16 8 lb per hp

The Fairchild 24

SERVICING SHORT CUTS

Beaching buggy

TO assist in beaching Consolidated Commodores at the Dinner Key seaplane base of Pan American Airways at Miami, a special dolly has been developed, which not only supports the rear end of the hull without danger of damage to the bottom plating, but also swivels freely to permit steering the plane into any desired location in the hangar or on the apron. The device was assembled from steel tubing and structural shapes and a pair of standard Ford automobile wheels. A heavy pin fastened upright in the dolly passes through a pair of open bearings attached to the stern post of the boat portion of the hull. The weight of the hull, however, is transferred to the dolly through a double-saddle arrangement into which the V-bottoms of both the float and tail rest. A quick-acting clamp holds the assembly together. An air-tight tank is attached to the buggy, which acts as a flotation gear, permitting the dolly to be floated in place under the stern of the hull before the boat is beached.

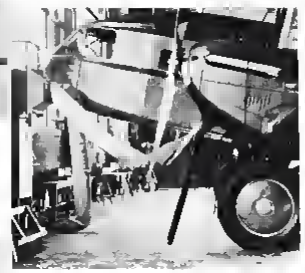
Engine heater

THE problem of keeping the Conqueror engines of the Curtiss Condors warm during overnight stops at the Atlanta depot of Eastern Air Transport, Inc., was successfully solved by a simple arrangement of canvas ducts attached to one of the regular hangar heating units. A sheet metal cone with two large circular outlets was built to fit over the discharge opening of one of the Dwyer steam-heating units installed in the hangar. A pair of heavy cylindrical canvas pipes was made up, one end of which was attached to the opening in the heater cone and the other end attached through a sort of canvas funnel to the underside of the engine nacelles. Warmed air from the heater was blown through the ducts and passed up through the engine nacelles. Sufficient heat was obtained to keep the engine and the lubricating oil warm enough for easy starting even in the coldest weather.

Oil can dolly

FOR moving lubricating oil cans or drainage drums about the hangars or the apron at the American Airways shops on Love Field, Dallas, a small structural iron and steel tube buggy has been built, on a pair of airplane tail wheels. It is arranged to accommodate either two 20-gal. containers of the milk-can type or to handle one standard 55-gal. oil drum. The cans stand upright in the buggy, but the drum is carried on its side in a strap iron cradle. A piece of steel chain is provided to lash the drum in the cradle.

Aviation

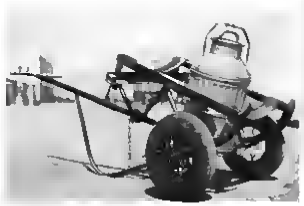


Pan American's special dolly for beaching Commodores at Miami. Right: Keeping the engines of an E.A.T. Condor warm by means of canvas ducts from an air heater

Aviation

Power distribution board

IN many hangars where power outlets are not available in the floor, the operation of small electrically driven tools or auxiliary lights in and around airplanes frequently results in a tangle of wiring under foot. In the Dallas shops of American Airways this situation has been eliminated through the use of gang sockets mounted on a small steel tube tripod. This unit is placed where power and light are required, and a single line is run from it back to the nearest power socket along the hangar wall. Individual connections for the various tools and lights are then made by simply plugging in to the distributor board.



Above—Power distribution easel. Left: An oil can dolly at the Dallas American Airways shops

Aviation

Safety signal

WHEN the Northrop Alpha airplanes are at rest on the ground, the air speed meter pitot head projecting from the leading edge of the left wing is only about 5½ ft. from floor level. To protect passers by from injury from striking this projection a red cloth flag attached to a tubular socket is slipped over the pitot head at all times when Alphas belonging to T. & W. A. are stationed on the apron or in the hangar.

AIRCRAFT AT WORK

Seaplane successful on short airline

AN excellent example of what may be done in the way of short line scheduled transportation with a single-engined cabin machine is afforded by the experience last year of Maine Air Transport, operating from Rockland, Me., over a 60 to 100-mile route touching a number of important points in the island-dotted Penobscot Bay region. During the six months between April 1 and Nov. 1 the line, under the direction of William Wincipaw, carried 3,909 passengers, at a gross income of about $17,000, an average of about 50 cents per mile. Between 400 and 500 persons were carried during some weeks in July and August. The average fare was $4.27. A simple arrangement for equipment and personnel permitted striking operating economies.

The main item in the investment was the flying equipment. This was cut down by buying a satisfactory used machine which had been flown 215 hours. The company bought a seaplane (J-6 Travel Air) in preference to an amphibion or flying boat because of the conviction that for this operation a seaplane accommodates greater payload, is faster, involves a lower initial investment and costs less to operate and maintain. A second seaplane was acquired later on as a reserve machine, an amphibion that was added still later has been disposed of.

There was no need of airport facilities, of course, and the limited ground equipment required involved practically no investment on the part of the company itself. Landing accommodations at the various stops consist merely of ordinary boat floats installed by the local agents, usually stockholders in the company. Each agent supplies the little that is needed in the way of personnel and equipment, and in return is allowed 10 per cent of the tickets he sells, besides whatever may be coming to him in dividends as a stockholder. This not only simplifies the ground problem, but serves as a stimulant to traffic promotion as well.

The remaining 90 per cent of the income is available to the company for running the Rockland headquarters, for new equipment and return on the investment. The only cash outlay is at Rockland. Pilots are paid by the hour; the total payroll never exceeds $130 per week, of which amount $85 covers the pay for mechanic, float attendants, office clerk, and the cost of rent, heat, light, telephone, advertising, and traveling expenses.

Routine inspection and maintenance is done at the Rockland base, repairs to the floats and major repairs to engine and plane were taken care of at the Curtiss-Wright station nearby. Patronage of Curtiss-Wright for extensive work eliminated any need for elaborate shop equipment and personnel. The second seaplane was bought to relieve the first for its periodical shop overhaul, but the first plane actually did 80 per cent of the flying during the six-month period.

Three round trips were made daily during the summer, two during the winter. As surface transportation is often unpleasant during the winter as well as slow, use of the plane is popular.

Trucking company depends on plane

OPERATION of a Stinson Junior in connection with their trucking business has proved highly satisfactory to the Clark Brothers Truck Transportation System, Watsonville, Cal. This firm uses a fleet of 33 trucks for hauling fruit, vegetables and general merchandise throughout the area between the San Francisco Bay region and Watsonville. The Stinson plane was purchased in March, 1931, and has been in steady use since then. Company records show that the total operating and maintenance expense does not exceed $6 per hour. The fact that the Clarks do all the piloting themselves and use the company's truck engine overhaul shop for maintenance work contribute to the low cost.

On their regular trips to Los Angeles, they make the complete round trip in one day, about one-third the ordinary travel time. They not only save time on such trips, but have actually saved money over the cost that would be borne by either automobile or railroad travel. The plane is also used for practically all personal transportation of the company executives to San Francisco and to the various small towns to which their many trucks operate, increasing effectiveness in obtaining hauling contracts and in dispatching trucks to best advantage.

The Clark Brothers' plane has been used in emergencies where savings of many hundreds of dollars were made through preventing extended tie-ups of trucks or other equipment. On one occasion a Watsonville contractor needed a small piece of machinery to replace a broken part. While awaiting the replacement more than 100 men were idle. The plane was used to deliver the part within two hours of the time the breakdown had occurred.

On numerous occasions the plane has been extremely valuable in rushing truck parts to the Clark shops in time to prevent a truck or trailer from losing a trip. The Clark Brothers standardize on Fageol trucks, which are manufactured in Oakland. By using the plane to rush important parts from the Oakland factory to the Watsonville truck shops they are able to avoid carrying a large inventory of parts, effecting a very material saving on this item without any sacrifice in maintenance standards. Also, the plane is occasionally used to carry parts out to equipment which has broken down on the road.

The Clarks believe aircraft soon will be an important link in the actual handling of goods by truck transportation systems, especially for handling perishables and other special commodities, and that it will be but a relatively short time before they will be doing some of their regular hauling by air.

Use plane to contact Cuba and Mexico

A COMBINATION business and pleasure tour of the southern states, Cuba and Mexico was carried out by a party of Fort Worth business men in January, in a six-place Wasp-powered Travel Air monoplane. The leader of the party was R. O. Dulaney, president of the Fort Worth Chamber of Commerce. His son was the pilot. The tour was made in sixteen days and covered 3,718 miles—335 of which were over the Gulf of Mexico—in 31 hours and 40 minutes. It was made without any trouble and demonstrates the possibilities of tours of this sort in making contacts even in such points as the West Indies and Mexico. Among the important stops were Jacksonville, Miami, Havana, Merida, Vera Cruz, Mexico City, Tampico and Brownsville.

The schedule permitted three days in Miami, several days in Havana and six in Mexico City. While in Yucatan the party flew from Merida to one site of Mayan ruins.

FLYING AND HOW TO DO IT, *by Assen Jordanoff. Grosset & Dunlap, New York, 1932, 113 pages.*

MR JORDANOFF'S exposition of how to fly is addressed to much the same audience as Captain Barnard's recent book Mr. Jordanoff gives much less attention than most of his predecessors in the field (far too little attention, we think) to the simple theory of flight He devotes much more space than is customary in such a work to cross-country flying and problems of navigation. About 60 pages of large type, widely spaced, go to the technique of flying proper. The book can be read in an hour without difficulty

It is marked by a simple and directly conversational style, being presented as a direct transcription of a verbal explanation The most distinctive features are the use of an enormous number of illustrations, including some of comic-strip type, and the scattering through the text of a collection of epigrammatic aviation commandments Maneuvers are graphically shown by sketches of the successive positions of the airplane and inset views of the position of the controls at each point. The possible consequences of doing the wrong thing are displayed by a number of cartoons and by such interpolated observations as "If you haven't been home for three nights, better not fly until you get some sleep", "Flying on the last drop of gasoline is just plain foolishness"; "It's easier to avoid getting into a tight corner than to get out of one", "A beautiful green field near the water may be like a rotten apple,—nice to look at but soft inside." Though we wouldn't recommend this as the best available guide for the man who wants to know what flying is like without having the opportunity to get a great deal of practical experience, there is no existing volume so well fitted to be given to a novice or to the man with some knowledge of the theory but no flying time, to read just before he takes his first lesson

PRINCIPLES OF FLIGHT, *by E. A. Stolker, Ronald Press, New York 1931, 428 pages, $6*

MR. STALKER'S book is entitled "A College Text on Aeronautical Engineering," and stands on middle ground between such works as Munk's "Fundamentals of Fluid Dynamics" and Warner's "Aerodynamics of Airplane Design." Less mathematical than the former, less directly concerned with application to design than the latter, the treatment is almost entirely theoretical in its background, with some data from free-flight tests but scarcely any from the wind tunnel The chapters are a mixture of the purely theoretical, comparatively simply treated (under such titles as "The Velocity Potential"), and the more directly practical (such as "Controls and Controllability" and 'The Airscrew") The work is admirably done and shows a real familiarity with the mathematics, without a passionate desire to introduce them at every point. Its worst defect is perhaps the scarcity of foot-notes, which are not entirely lacking but might well have been several times more numerous. It is undoubtedly the best existing text for the general collegiate course in aeronautical theory especially a course that is to be taught by a man of strongly mathematical leanings

1927 SCHNEIDER TROPHY CONTEST, *Collected Reports on British High Speed Aircraft, British Aeronautical Research Committee, 1931, H. M. Stationery Office, London, 372 pages, $5 approximately*

THIS is a unique book. Nothing like it has ever been attempted before. From the first page to the last, it is devoted exclusively to the development of the Supermarine, Gloster, and Short Crusader airplanes which went to the Lido in 1927 and brought the Schneider Trophy back to London. It will answer at least a hundred questions that have been asked in vain during the past five years of British development of high-speed seaplanes. The Schneider Trophy is now permanently domiciled in the Royal Aero Club and the Air Ministry sees fit to tell the story of its capture.

It will give some idea of the scope of the book to say that there are 24 separate research reports They cover the relative effects of projecting and counter sunk rivets in the floats; the effect of a corrugated wing-skin radiator on the drag; the cooling power of the wing radiators finally used; the planing characteristics of the floats; the effect of a reduction of the weight of the reciprocating masses on the permissible maximum running speed of the engine used; the record of trials on a number of alternative propellers; and a variety of other information.

Passing from research to practical design, the Supermarine S-5, the Gloster and Crusader planes, and the Napier and Bristol engines are written up in detail by individuals intimately connected with their development. The static tests made upon parts of the structure, and especially on the monocoque fuselages, are recorded.

Progressing from research, design, and construction to operation, brief accounts are given of flight tests made on the Supermarine machine and of the studies of high-speed cornering that lead to the adoption of a standard practice in taking turns with racing machines The volume closes with a description of the 1927 Schneider race and an analysis of speeds and times and an annotated tabulation of all the flights ever made by the winning machine

To criticize such a monumental volume, incorporating contributions from a score of authors, is quite futile It is, as we have already suggested, unique. Everyone interested in any degree in the development of high-speed aircraft ought to take a week off and study it carefully

STANAVO PILOT'S HANDBOOK, *Stanavo Specification Board, Inc., 120 pages; 1932, presented to licensed pilots on request*

THE fourth edition of the much-used Stanavo Pilot's Handbook has profited by experience with the earlier editions.

Additional information has been inserted, and in such form that reference to it is more convenient than before Particularly useful is a series of maps of radio beacon installations. The radio section again fills the largest share of the printed portion of the book, a full 42 pages About two-thirds as much space is given to aviation fuels and lubricants and engine data, some of it general, some of it relating specifically to Stanavo products and the channels through which they are supplied. Among other odds and ends the volume contains maps of the continents and of the United States, outline maps showing airways all over the world, a summary of the air traffic rules and of the ways in which the government weather service can be used, a list of the most important world's records, and sundry simple navigational tables A course protractor is included in the pocket of the back cover The notebook proper, or scratch pad is in a perforated loose-leaf form much more convenient than the standard pad furnished in 1931

As noted above, the book will be sent on request to any licensed pilot.

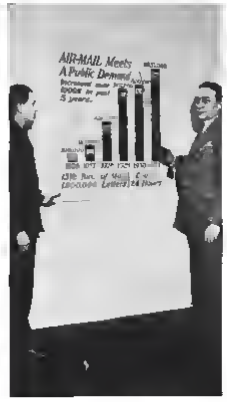
TRANSPORT

Operations and Traffic Management

Chart talk promotes interest in airlines

T. PARK HAY, a sales executive of Transcontinental & Western Air, has prepared an illustrated chart talk on the development and effectiveness of air transportation for presentation before civic clubs and executive groups The charts are carried in a convenient roll and, on display, are supported by a portable metal easel The presentation takes only twenty minutes, it briefly sketches the development of air mail and air passenger traffic and the installation of federal airway aids to air navigation Comparisons are made with some aspects of air transport development abroad. An interesting feature is a prediction of passenger mail and express traffic expected by 1937

This talk is available to clubs and other groups without charge, and appears to be an effective method of acquainting business leaders with the service now offered by American airlines and stimulating interest in patronizing this service After the talk, opportunity is provided for answering questions and making additional remarks of interest to the particular group addressed.



Illustrating air mail growth, one of the charts used in T & W A s air transport talks

Traffic promotion through hotel contacts

DIRECT contact with prospective passengers is being attained by Eastern Air Transport in the majority of the cities it serves by placing a sales letter in the mail boxes of hotel guests who are registered from cities served by the company Five per cent of the letters distributed thus in Atlanta hotels during a six-month period produced ticket sales, a highly satisfactory response

The scheme has been found to be particularly effective during the first year a community is included on the line's route. It may be sponsored, and the expense shared, by two or more airlines serving the same community, as at Atlanta, where Eastern and American Airways cooperate. The letter includes in its sales message the suggestion that the prospect stay over night in the hotel and use the plane the next day, a feature which assures the cooperation of the hotel management

Eastern is now preparing simplified schedule and rate sheets which will be easy to read and attractive in make-up Sheets are prepared for use in each of the 26 cities served by the line with all information presented from the standpoint of the city in which the prospect happens to be Destinations from that particular point are listed alphabetically and by reading straight across the page from the selected destination one finds the route, departure time arrival time, one way fare and round trip fare

Certificate system for airline tickets

PAN AMERICAN has introduced a commercial transportation certificate for the convenience of business concerns trading with Latin American countries The certificate is issued in any amount desired and when presented at any agent of the system tickets will be issued at one way rates up to the total amount shown on the face. Thus a representative wishing to cover a widely scattered territory served by Pan American may purchase transportation to suit his schedule by merely presenting the certificate at a Pan American office. The only cash involved in the actual reservation of accommodations is the payment of the government ticket tax where required Letters of identification are issued in conjunction with the certificate to safeguard the users.

Special discounts are in effect at the present time. Thus $2,500 worth of transportation on the system may be bought for $2,187.50, a discount of 12½ per cent Transportation ordinarily costing $10,000 may be bought for $6,000, a discount of 40 per cent

Passengers listen to radio conversations

THE practice of permitting passengers to listen in occassionaly on plane-ground radio conversations has been tried out successfully on Transcontinental & Western Air There are two head sets in the cock-pit and the one not in use by the pilot at the controls is given to the passengrr, after a short description of the general operation of the radio system by the other pilot, and the passenger gets a first hand introduction to the way the device works No written orders have been issued to the pilots regarding this innovation, but they have been requested by the operations office to carry it out whenever it does not interfere with flying, so that each passenger may listen in

Desk map gives information for landings

H. A GIBB, southern division radio supervisor of American Airways, at Dallas, has devised an electrically-lighted desk map of the Dallas Airport for the use of radio telephone operators in advising arriving pilots of the direction of wind, its velocity, and the correct runway for landings The map of the airport appears in black drawing ink on a sheet of ground glass, which is mounted on a frame hinged on one edge of the map cabinet

Under this glass cover are eight 10-volt lamps in a circle around the edge of the field The lamp which is lighted indicates the direction of the wind and the observer can see at a glance which runway should be used Wind velocity is obtained by a ninth lamp located at the intersection of the runway. This indicates velocity by the number of flashes, similar to the usual buzzer The lights indicating direction of wind are in circuit with a contactor built into the weather vane unit

THE BUYERS' LOG BOOK

Recording camera

A special camera, designed for recording the take-off or landing of airplanes, or other performance data on moving vehicles, has been designed in Germany, and is being distributed in the United States by Carl Zeiss, Inc., 485 Fifth Ave., New York.

The equipment consists of a camera incorporating a stop watch and memorandum tablet, to be photographed simultaneously with the objective, a film changing box and a tripod stand. From a series of photographs of an airplane take off or landing, it is possible to calculate the plane's performance. The complete equipment including camera, changing box, and stand, weighs 31 lb —AVIATION, *June, 1932*

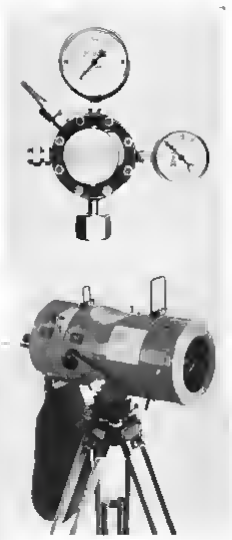
Gas welding equipment

Several new features have been recently announced by Linde Air Products Company, relating to their welding equipment and material. A new series of welding heads with detachable tips has been introduced for use with the Oxweld type W-17 blowpipe. These supplement the one-piece head so that users now have a choice of two types. Sizes 6 to 13 inclusive are available in the new style. In addition, a new series of Purox regulators for oxygen and acetylene gases have been introduced. The required volumes of oxygen and acetylene essential for maintaining a neutral flame at the blowpipe type are automatically delivered to the blowpipe at uniform pressure.

Coincident with the announcement of the above improvement in apparatus, a new welding flux is being marketed which has been developed especially for use in welding the chromium alloys, generally known as stainless steel or rustless iron. Ordinary fluxes used for welding or brazing are not satisfactory for stainless steel, because they do not dissolve the infusible oxides which tend to form on the molten surfaces of such alloys. The new Cromaloy Flux has been designed to be sufficiently fireproof to protect the molten metal, and at the same time dissolve the refractory chromium oxide.—AVIATION, *June, 1932*

Machine tender

The Stackbin Corporation, of Providence, R. I., manufacturers of sheet metal bins and metal cabinets, has announced an enclosed type, sheet metal Machine Tender, designed to hold small tools, chucks, gears, etc., at a lathe, drill press, etc. The machine operator is thus provided with a personal cabinet, for which he can be held responsible, and which will contain everything which he needs for the operation of his machine. The cabinet is provided with a bench top, shelf, and doors provided with a padlock hasp. They can be supplied with or without casters. The overall dimensions are: 18 in. deep, 30 in. wide, and 32 in. high.—AVIATION, *June, 1932*



Top: Linde Purox regulator
Above: Zeiss recording camera
Left: The Stackbin Machine Tender

Metal cutting band saw

Individually driven band saws, designed primarily for cutting metals are manufactured by William Ladlaw, Inc., of Belmont, N. Y. These machines are provided with eight speed changes, ranging from 100 to 725 ft. of saw travel per minute making it possible to adapt the cutting speed to the material being cut. The work tables are provided with full hydraulic feed. The feed pressure may also be controlled to suit the work. The table may be adjusted to cut off stock at any desired angle and vises for special purposes may be mounted on it. —AVIATION, *June, 1932*

Blue printing machine

A new process for producing both blueprints and blueline prints has recently been developed by the C. F. Pease Company, 813 North Franklin St., Chicago, Ill. The operation is known as the "Kyano" process, and is incorporated in the new Model 25 and 30 continuous blue-printing equipment manufactured by this company. The older Models 10 and 20 now in operation may readily be adapted to handle printing by the new process. The manufacturers claim that prints made by the Kyano are exceptionally clean-cut and will last longer without fading than those made by the earlier methods.—AVIATION, *June, 1932*

Aluminum welding electrode

The Lincoln Electric Company of Cleveland, Ohio, has recently announced a new electrode for welding aluminum. It is a 5 per cent silicon aluminum alloy, designed for use with either metallic or carbon arc welding, of sheet or cast aluminum, and marketed under the trade name of Aluminweld.

Welding rods are provided with a coating of flux, which prevents excessive oxidation and will dissolve any aluminum oxide that might be formed. It is claimed that the resulting weld is of great density and high tensile strength and can be polished satisfactorily with little discoloration. Material is produced in four sizes, ranging from $\frac{1}{16}$ to $\frac{1}{4}$ in. and is shipped in standard 14-in. lengths.—AVIATION, *June, 1932*

• One of the TWA coast-to-coast planes landing at the municipal airport, Kansas City, en route to Los Angeles and San Francisco from New York.

The shortest route from coast to coast with TWA *and* TEXACO

TRANSCONTINENTAL AND WESTERN AIR, Inc., operates the shortest route from coast to coast. Fifty air liners are in service between New York, Los Angeles and San Francisco, and three gigantic hangars have been erected at Columbus, Kansas City and Los Angeles. • TWA planes make the trip from the Atlantic to the Pacific in 22 hours, 2 minutes, flying time. More than 20,000,000 miles have been covered during the past 6 years. • Texaco Airplane Oils are used exclusively. This is in keeping with the high efficiency of TWA planes. Texaco Airplane Oils were selected, after exhaustive tests, for all planes of the Transcontinental and Western. Another tribute to the effectiveness of Texaco Lubrication.

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TEXACO AVIATION GASOLINE
TEXACO AERODIESEL FUEL
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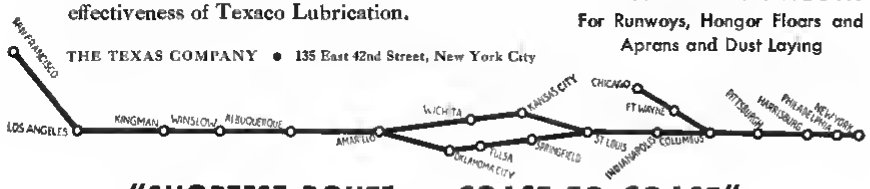
TEXACO ASPHALT PRODUCTS
For Runways, Hangar Floors and Aprons and Dust Laying



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JIMMIE DOOLITTLE

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What tire do they use? AIRWHEEL!

THE men who know the most about flying don't take any chances with landing equipment.

They want tires that wipe out every possible hazard of plowed ground, swamp land, sand, snow or muddy fields.

That's why on the planes shown here — and on the personal ships of a long list of other veteran pilots — the tire you find is the Goodyear AIRWHEEL.

For safest landings and take-offs, for quickest, surest, smoothest braking, for real savings in maintenance costs, there's just one tire to use and only one company builds it, because only Goodyear builds the Airwheel.

For complete engineering data, specifications and recommendations for equipping your ships, write or wire to Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

TUNE IN:
Goodyear invites you to hear the Revelers Quartet, Goodyear Concert-Dance Orchestra and a feature guest artist every Wednesday night, over N.B.C. Red Network, WEAF and Associated Stations

When You Buy a New Ship Specify *Goodyear Airwheels*

GOODYEAR

IF IT ISN'T A GOODYEAR IT ISN'T AN AIRWHEEL

Why *written* messages flash along the airways

A NEW AIR LINE was ready to be opened. Planes had been bought. Airports selected. Schedules arranged. To head the enterprise, a young executive of wide experience had been chosen.

"We will want all our airports, and the principal central-city offices linked together by Teletypewriters," he said. "They are important to nearly every phase of our operations."

Teletypewriters flash instant, *written* messages between connected offices. Pressing a key on one machine prints the corresponding character on any or all other machines, a few hundred feet or thousands of miles away.

This means maximum speed and absolute accuracy in the exchange of information . . . two things of vital importance where the operation of airplanes is concerned. It contributes to safety in flight. Punctuality of schedules. Economy in handling traffic.

Teletypewriters are of value in sending and receiving last-minute weather reports. Plane movements. Reserving or releasing passenger space. Mail and freight information. Executive instructions. Accounting matters. Equipment requisitions.

Manufacturing concerns, as well as operating companies, are using Teletypewriter Service to advantage. Your local Bell company will gladly help you determine whether it can benefit your business. Just call the Telephone Business Office.

THE NEW TELETYPEWRITER SERVICE

The recently announced Teletypewriter Service permits any subscriber to it to typewrite by wire instantly to any other subscriber, whether he be around the corner or across the continent. This service differs from private line Teletypewriter Service, described above, in that any subscriber may ask for any other subscriber and be connected immediately by the teletypewriter "central"

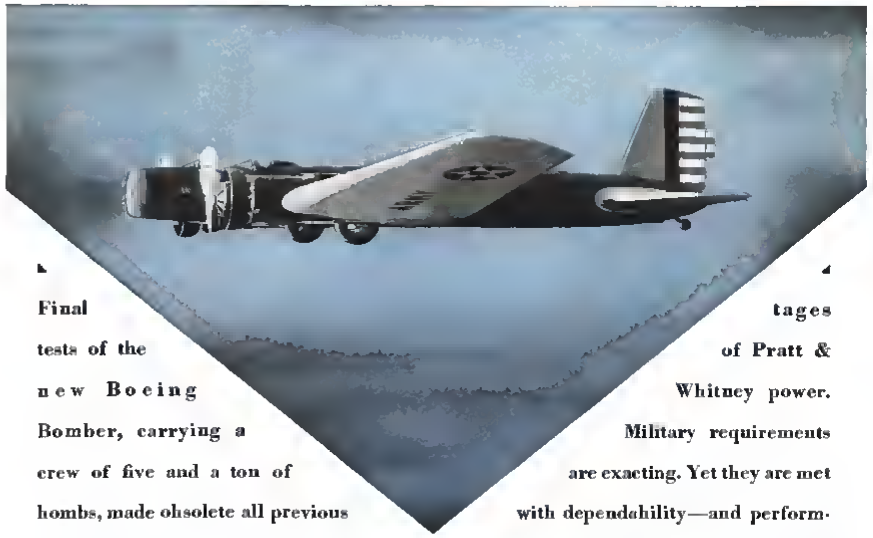
TELETYPEWRITER SERVICE

EXACTING TESTS

WROTE

HORNET ENGINES

into the specifications of the new Boeing Bomber



Final tests of the new Boeing Bomber, carrying a crew of five and a ton of bombs, made obsolete all previous concepts of load and speed for this type of military plane. And the same tests recorded in cold figures the basic advantages of Pratt & Whitney power. Military requirements are exacting. Yet they are met with dependability—and performance to spare—by the Series B-1 geared and supercharged Hornet engines which power the world's most advanced bomber.

THE PRATT & WHITNEY AIRCRAFT CO.
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Division of United Aircraft & Transport Corporation
Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Germany by Bavarian Motor Works, Munich; and in Japan by Nakajima Aircraft Works, Tokyo.

Wasp & Hornet Engines

BE KIND TO OLD MAN PISTON

(Illustration Courtesy "The Sportsman Pilot")

IN a modern 300 horsepower aviation engine:—

He may travel more than 21 miles in one hour's time, just thrashing back and forth and never getting anywhere.

He may, in the same hour, start and stop nearly half a million times.

In starting from rest he may accelerate to a speed of more than 40 miles per hour in less than 3 inches distance, and in the next 3 inches decelerate to rest again!

He may carry a maximum load of nearly 4½ tons on his head.

His temperature may reach 600° F.

Even using good gasoline you bathe his head in fire; using a poor gasoline that knocks intensifies the heat and the headache.

Even with good lubricating oil he has nothing but an infinitesimal film to protect him from the hot metal walls of his cylinder prison

Excuse enough that sometimes he may shoot himself "right through the head."

Be kind to Old Man Piston. Give him only the best—Stanavo Aviation Gasoline and Stanavo Aviation Engine Oil.

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AVIATION GASOLINE AND ENGINE OIL
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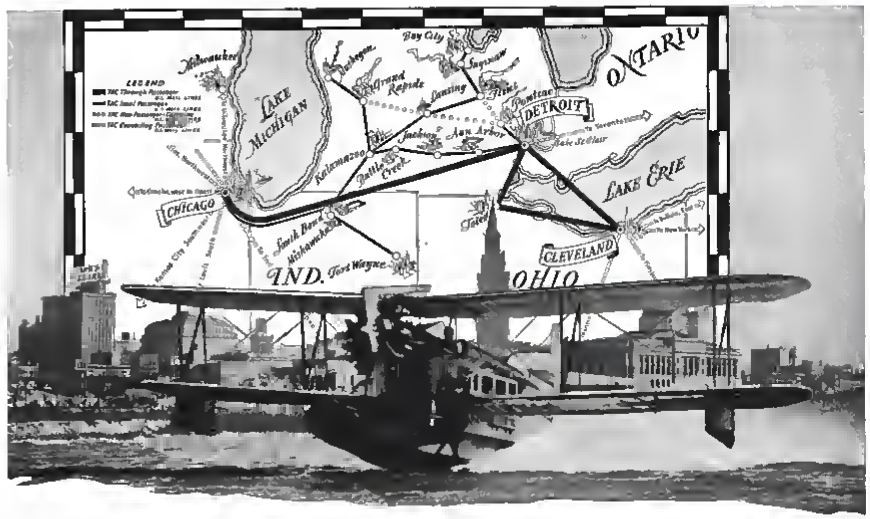
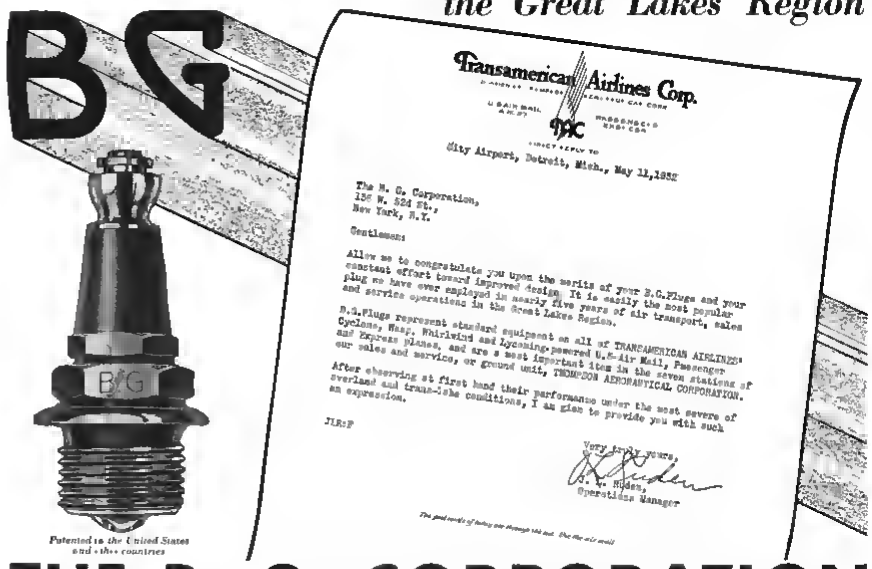


Transamerican Airliners *fly 5400 miles a day in the Great Lakes Region*



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Pioneer Magnetic Compass—a well known instrument made better by a new resilient mount which absorbs vibration, and an improved method of compensation, more adaptable by a new bracket allowing better grouping of adjacent instruments.

Pioneer Drift Indicator—a compact instrument which shows the drift angle exactly. Simple in construction and easy to install. The pilot adds to or subtracts from his compass reading to correct his course

These Pioneer Instruments, together with all other products in the Pioneer line, are examples of a desire to lead in development of new products and the improvement of the present High standards of precision workmanship and careful inspection during and after manufacture, all go together to uphold the standard set by Pioneer.

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PRICES REDUCED *on all* FLYING COURSES

MORE millions have been spent by United Aircraft & Transport Corporation, over *all* the branches of commercial aviation, than by any other organization in the world.

These nationwide resources, including the experience flown out of 40,000,000 miles of transport operation, are the "built-in" background of every flying career begun at the Boeing School of Aeronautics

Its training exceeds the requirements of the Department of Commerce.

Its fleet of planes is the largest, and its laboratories, shops and class-rooms the most modern, of any commercial aviation school in existence.

Its pilot instructors are veterans who have given more than a million miles of student-instruction flying at Boeing School.

More students are now regularly enrolled in the Boeing School than in any other—and they will be *ready* for service as pilots and mechanics when they graduate! Not only the great United organization but other transport and manufacturing companies know that Boeing graduates are their best young material.

INFORMATION Employers or students can best form their own opinion of Boeing standards from the bulletin of courses. It gives full details regarding enrollment requirements, costs, facilities, etc. Fill in and mail the coupon for a copy and compare with any other school.

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- ☐ Special Master Pilot (For Transport Pilots)

Name_____ Age_____

Address_____

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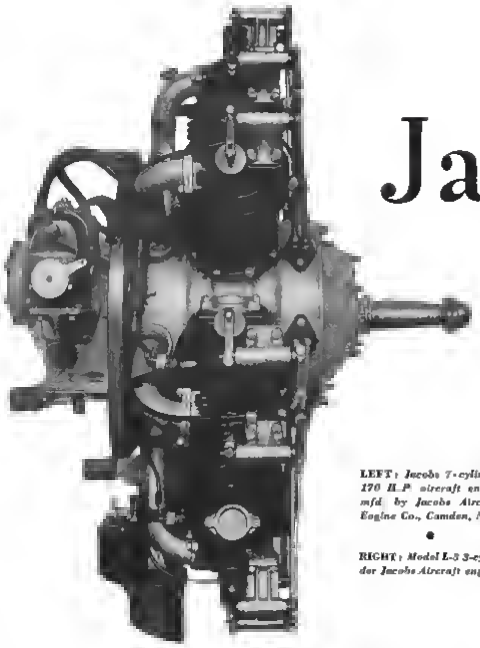
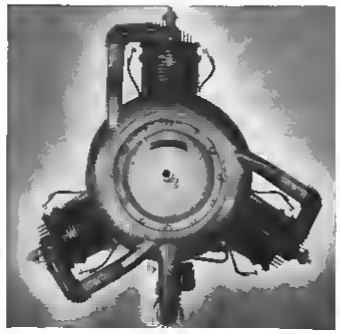


Jacobs...

LEFT: Jacobs 7-cylinder 170 H.P. aircraft engine mfd. by Jacobs Aircraft Engine Co., Camden, N. J.

RIGHT: Model L-3 3-cylinder Jacobs Aircraft engine.



another aircraft engine maker who relies on

NICKEL ALLOY STEEL!

• Jacobs is another aircraft engine manufacturer who has confidence in Nickel Steel's performance. Important ports in Jacobs airplane engines hove strength, toughness, and resistance to impact, shock and fatigue. For they are made of dependable Nickel Alloy Steel. • Nowadays when an airplane engine manufacturer seeks utmost dependability, he specifies Nickel Alloy Steels. Thot's because the experience of leading manufacturers all over the globe proves conclusively that Nickel Alloy Steel parts provide that extra margin of safety, and that they "perfarm better longer" in aviation service. • If you need helpful assistonce in selecting suitable Nickel Alloy Steels for aviation requirements, consult our technical staff.

Nickel Alloy Steel parts in Jacobs airplane engines

Crankshafts	Piston pins
Connecting rods	Oil pump shafts
Cams	Rocker arms
Gears	Valve operating parts

Bolts, studs, nuts and keys

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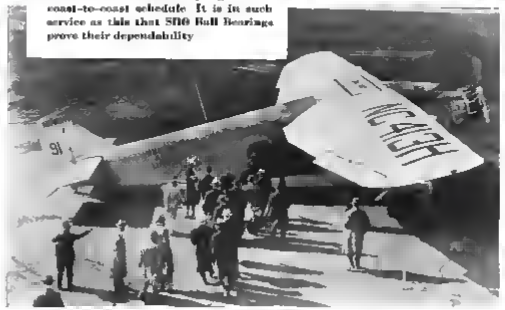
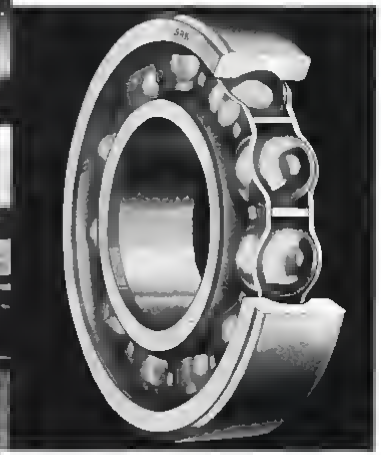
United Air Lines carry half the air mail in the United States. Last year they flew 6,000,000 miles at night. Above is shown a Boeing Mail Plane about to take off on its regular "after dark" trip. The Hornet Engine . . . using SRB Ball Bearings . . . assures dependable power for night flying.

This 9½-ton Boeing transport, powered by three 525 H.P. Hornet Engines with SRB Ball Bearings, cruises 115 m.p.h. with a load of fourteen passengers, 1,000 pounds of mail, express and baggage on United Air Lines' twenty-eight hour coast-to-coast schedule. It is in such service as this that SRB Ball Bearings prove their dependability.



The Ford Tri-Motors flown by United Air Lines have Wasp Engines equipped with SRB Ball Bearings.



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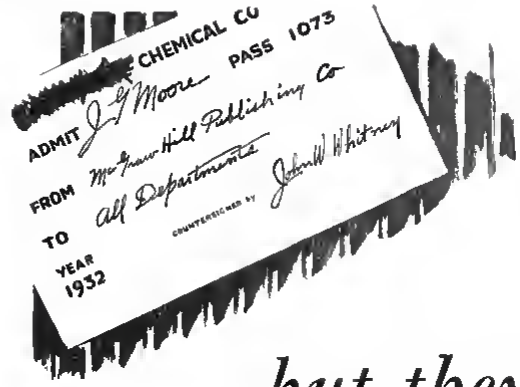

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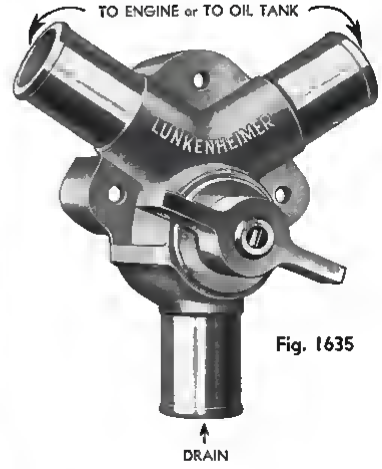

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FOR SALE Challenger Robin perfect condition motor just overhauled. Best offer over $1,300 cash. H M Jackson Jr. 23 Cliff Ave., Winthrop Mass

FOR SALE Almost new Kinner B-5 motor would trade with a late model car. Hans Stocklasser 210 Harrison Rome, N Y

FOR SALE Damaged Curtiss-Wright Jr Szekely 15 hours. Make offer. Want Pusher Fuselage and parts. H Schnetze, Waukesha, Wisconsin.

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FOR SALE Heath Parasol ready to fly-away. Any reasonable offer whole or part. Must be cash or certified check. Need money bad. Canfield Airport, Waterloo Iowa

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FOR SALE Factory rebuilt late type Kinner K-5 100 hp engine with front exhaust heads and need more overhauled by factory price $640. An excellent buy. Charles Thompson 814 Irving Street Alhambra Calif

FOR SALE Kinner Fleet licensed till May 1933 Excellent condition recently completely overhauled. Address Kermit Fischer 2408 Lincoln Drive, Germantown Philadelphia

FOR SALE One practically brand new three-place special De Lux Fleet flown 120 hours Kinner 125 engine, dual brakes air starter steel propeller. All instruments never cracked, perfect condition new ship guarantee. Financial conditions forcing me to sell at once. Terms Wire Paul Smith Plymouth Ind

FOR SALE

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J-5 WACO Straightwing Perfect condition. 229 hours 25 since overhaul. Latest model with tripod landing gear. Equipment includes 9.50x12 low pressure tires, electric inertia starter, Townend ring, non-shatter glass windshield streamline cockpit cover, complete instruments including rate of climb and turn and bank indicators, Irvin chute, glass navigation lights dual controls. Tiedex gas and oil lines. Always hangared and never cracked. Covering like new. Well streamlined plenty fast. Owned by sportsman and always kept in perfect shape. For pictures and full details of this wonderful buy communicate with John Strallee River Road, Milwaukee, Wis

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MONOCOUPE new covering on fuselage, wing cover good motor excellent. $279 cash. Cannot be licensed. Will consider car. Lombard Airport Lombard Ill

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when confronted with unusual problems. This Section lists professional assistance to aid in working out patent problems that require the benefit of the broadest knowledge and experience.

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SEARCHLIGHT
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AIRCRAFT SERVICE DIRECTORY

PROFESSIONAL SERVICES

WHERE TO FLY

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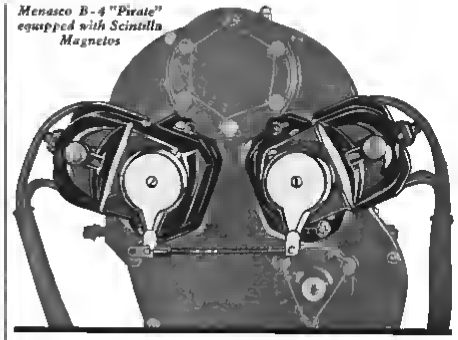
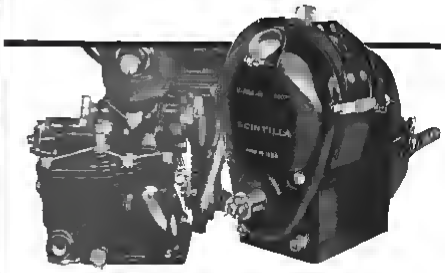
Menasco B-4 "Pirate" equipped with Scintilla Magnetos



MENASCO and SCINTILLA



Menasco Motors, Inc., point with pride to the fact that their B-4 "Pirate" engine has been used by such well known airplane manufacturers as Waco, Northrop, Ogden, and Gee-Bee, for three years, without a single failure.

Scintilla, too, can point with pride to Menasco's service facts. Two Scintilla Magnetos are standard equipment on the B-4 "Pirate". It's another good example of the sturdy dependability of Scintilla.

SCINTILLA MAGNETO CO., INC.
SIDNEY, N. Y.

Contractors to the U. S. Army and Navy

(Subsidiary of Bendix Aviation Corporation)

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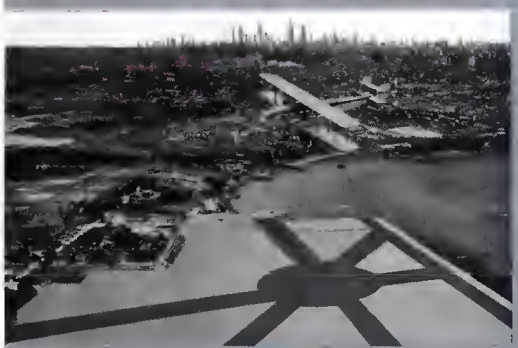

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